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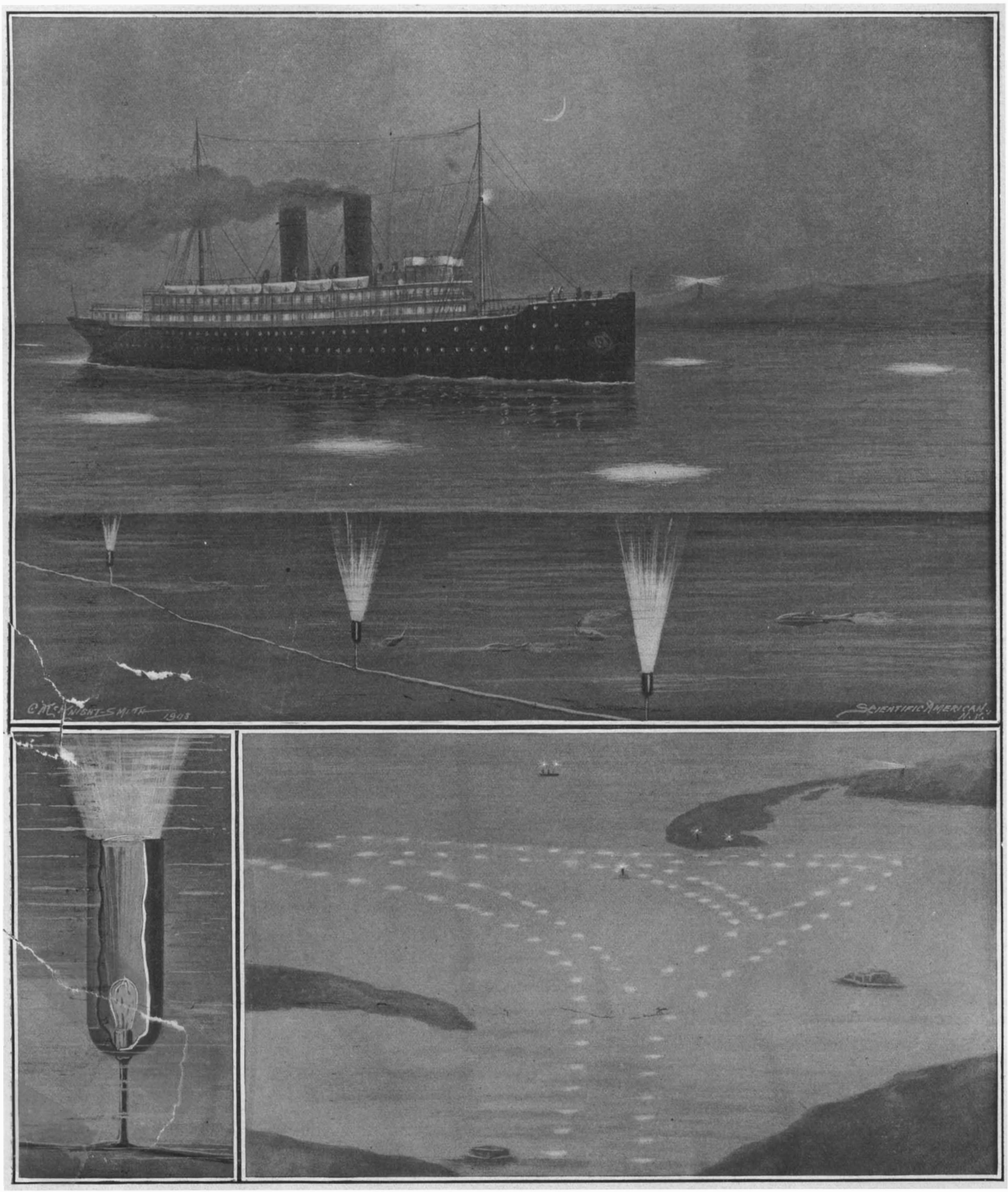
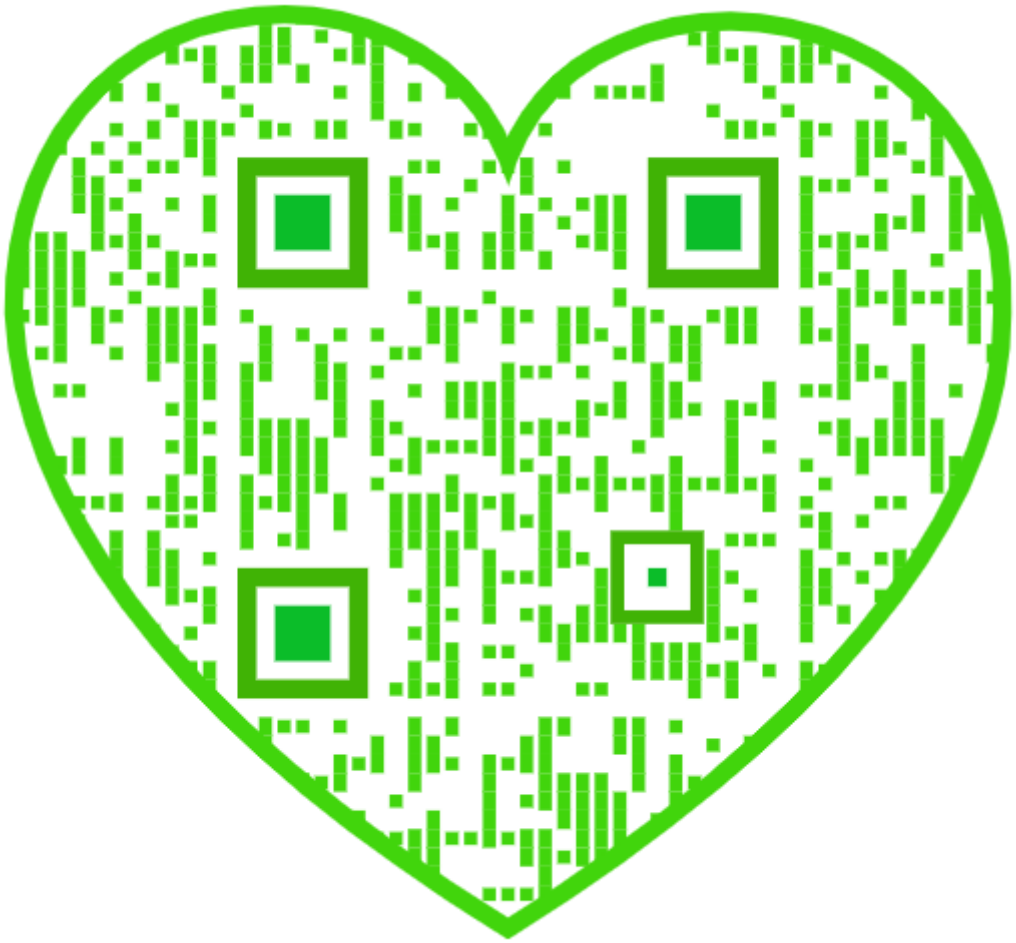


The Channels Are Outlined by Patches of Light on the Surface Produced by Submerged Lamps Anchored to the Harbor Bottom.

A UNIQUE SYSTEM OF ILLUMINATION FOR HARBOR CHANNELS.—[See page 203.]



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NEW YORK, SATURDAY, MARCH 21, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

JOINING THE BLACKWELL'S ISLAND BRIDGE CANTILEVERS.

About the time that this issue is in the hands of our readers, the erecting gantries of the Blackwell's Island bridge across the East River will be swinging the last panels of the big cantilevers into position for pinning up by the bridge gangs. When this is done, another great thoroughfare will have joined hands from opposite shores of the East River, and the insular disabilities of Manhattan Island will have secured that much more relief. In some respects this bridge is unique among the big bridges of the world. It is the longest and the heaviest cantilever structure, not even excepting the Forth Bridge in Scotland; for although the two cantilevers of the Forth Bridge are more than fifty per cent longer than the longest cantilever in the Blackwell's Island Bridge, the latter is much the greater in its entire length, which, including the approaches, will be 8,230 feet. Moreover, the capacity of the Blackwell's Island Bridge is far greater than that of the Forth Bridge, there being accommodation on its two decks for four trolley tracks, two railroad tracks, and two roadways, besides the customary footpaths for pedestrians. The Forth Bridge, on the other hand, provides for only two railroad tracks. The carrying of such a great moving load, amounting, as it does, to 14,000 pounds to the linear foot, necessarily makes the bridge very heavy, and the massiveness of the steel members is one of the first impressions made on the spectator. The two cantilever spans of the Forth Bridge are each 1,710 feet in the clear; the two river spans of the Blackwell's Island Bridge are respectively 1,182 and 984 feet.

NEW TRANSATLANTIC RECORDS.

With the coming of calmer weather on the Atlantic, the new Cunard steamers are beginning once more to cut down the time of the transatlantic passage. On her last trip to the eastward over the long route of 2,932 knots, the "Mauretania" succeeded in bettering her own best previous passage to the eastward by over two hours and a half, the trip being made in five days and five minutes at an average speed of 24.42 knots an hour. Her best day's run was 595 nautical miles, at an average speed of 24.77 knots. During the same week the sister ship "Lusitania" made a record run from noon to noon of 627 knots, or 3 knots better than the previous best day's run of 624 knots, made last autumn by the "Mauretania." According to the contract with the government, these ships must complete a round voyage at an average speed of 24.75 knots an hour, if they are to secure the annual payment of $700,000 which is included in the terms of the contract. When the suitable conjunction of smooth seas and clear weather is afforded, the two ships, judging from these recent performances, should have no difficulty in fulfilling the government conditions.

A NEW EXPLANATION OF RAISED OCEAN BEACHES.

One of the most startling facts revealed by a study of geology is that the greater part of the earth which is now dry land has at one time or another been covered by the ocean. There can be no doubt of this. The fossil remains of shellfish, corals, sea lilies, and other marine forms at high elevations can have no other explanation. In many places the ancient shore lines may clearly be seen. Benches carved out of rocks by the action of the waves or gently sloping beaches lined with characteristic sand dunes can readily be identified, even though now covered with vegetation. That such vast inundations have been frequent is shown by the large number of beaches which rise like terraces, one above the other, in certain localities.

These beaches have been used to argue that the earth on which we dwell is far from the immutable body one would think it to be, that it is subject to great upheavals and depressions; not sudden eruptions, such as produced by volcanic forces, but movements which have been slow in the extreme; enormous areas slowly but irresistibly pushed up out of the depths of the ocean by stupendously powerful forces acting through ages of time; huge mountain ranges that have resistlessly been dragged down and overwhelmed by the sea.

Geology being a study of the earth in all its aspects covers a very broad field, and necessarily has much in common with most of the other sciences. It is interesting to note that where it comes in contact with astronomy and physics, there are a number of points of friction. Despite the evidence of raised beaches and of tilted and twisted strata, astronomers and physicists claim that the earth is a stable body more rigid than steel, and they are very skeptical about the vast terrestrial disturbances called for by geologists. For, were the earth less rigid, the enormous tidal influences of the sun and moon would constantly bend and distort its surface, causing waves of flexure to travel around the globe in much the same way that the ocean tides now act.

Efforts to reconcile geologists to this school of belief, hitherto have been unavailing. No one can deny the identity of the raised beaches; and how account for them, except that they were bodily raised to their present position, or ponded by ice dams? The fact that ancient raised beaches are not parallel with the present sea level, but are inclined thereto, would seem to indicate that their present elevated positions are due to upheavals of the land rather than subsidences of the ocean.

Oddly enough, this inclination of the beaches, though pointing so clearly to the idea of a non-rigid earth, is used as a basis for a brand-new theory which argues the very opposite. The author of this theory, Mr. H. W. Pearson, has been studying raised beaches for twenty-five years, following the beaches on foot for thousands of miles through the United States, Canada, and Europe, surveying and minutely investigating them, gathering the statistics of other investigators, and tabulating the data thus obtained. As a result he has deduced a law for the inclination of the beaches, and advanced a most fascinating theory to account for them. Starting with the Boulevard Beach, 1,075 feet above sea level, at his home town in Duluth, Minn., he found that it had a rising gradient toward the north. Other beaches at the same latitude showed precisely the same gradient. Correlating a vast number of beaches, extending with but few gaps from near the equator to the northern extremity of Greenland, he found that they form a continuous curve, which starts from the sea level at the equator and rises approximately as the sine of the latitude until, if extended to the pole, it would there have an altitude of 1,467 feet above the present sea level. A similar line of beaches conforming to the same law of sines was traced through Europe and nearly to the equator in eastern Africa. Other lower beach lines were investigated, merging into the present sea level at or near the equator and rising to various levels at the pole, but forming continuous curves which follow the same sine law deduced from the first line of beaches. Had these beaches been raised by uplifts of the land, it is inconceivable that the upheavals should have been of so uniform a character. If, on the other hand, the earth were rigid and the ocean overflowed the northern hemisphere to the extent indicated by these curves, it must have done so at the expense of the waters of the southern hemisphere, and such a change could be brought about only by a shift in the center of gravity. Mr. Pearson falls back upon astronomy to account for such a shift.

It is well known that the seasons are caused by the inclination of the earth's axis of rotation to the plane of the ecliptic. That is, the earth's axis, instead of standing upright as it revolves about the sun, leans over at an angle of about 23½ degrees. Hence first one pole, and then the other is exposed to the sun's rays. When the north pole points away from the sun the latter is low in the sky, and winter prevails in the northern hemisphere. Six months later, when the earth is at the opposite side of its orbit, the sun beats full on the Arctic regions, while winter obtains in the southern hemisphere. Now the earth's orbit is eccentric with respect to the sun, and it happens that the northern winter begins when the earth is nearest the sun, and the southern winter when the earth is some three million miles farther away from the sun. As a result, the southern winter, under the Adhemar Croll hypothesis, is longer and colder than that of the north, and though, to be sure, the southern summer is slightly warmer, the average for the entire year is colder than that of the northern hemisphere. This accounts for the fact that the Arctic ice cap, which is found mainly in Greenland, consists of but one million cubic miles, while the Antarctic cap is estimated at forty million cubic miles. But astronomers find that the earth's axis is very slowly gyrating in a period which is completed in about 21,000 years; so that about 10,000 years hence it will be inclined in a diametrically opposite direction. Then the northern hemisphere will have its summer in December, and a colder winter beginning in June. That should mark the beginning of the second glacial epoch in the North, and a gradual reduction of the ice cap in the Antarctic. In other words, every 21,000 years, there will be a glacial period in the North, and these periods will alternate with similar ones in the South, which is now experiencing a glacial epoch.

This idea is not entirely new to science, and it is admitted that the preponderance of ice first at one pole and then at the other will produce a corresponding shift of the center of gravity of the earth. Others, however, have gone a step further, showing that a slight displacement of the earth's center of gravity would be accompanied by a flow of water toward the overweighted pole. This would result in a further shift of the center of gravity, and would be accompanied by a still greater rise of water in the polar regions, until at the limit the displacement of the center of gravity would be ample to account for the raised beaches.

Such, in brief, is an outline of the new theory. Its importance lies in the fact that it seeks to establish law and chronology in the epochs of geology, and if accepted would affect many other branches of science. While it is the policy of the SCIENTIFIC AMERICAN to avoid as far as possible the consideration of purely theoretical subjects, the originality of Mr. Pearson's work, and its support by prominent scientists, has influenced us to make an exception of this case, and we have decided to publish the matter in full in the SCIENTIFIC AMERICAN SUPPLEMENT. Even those who cannot accept Mr. Pearson's views should find the matter most interesting and worthy of investigation. The current SUPPLEMENT contains the first of the series of articles written by Mr. Pearson.

COMPETITION IN SUBMARINE CONSTRUCTION.

The matter of submarine legislation has reached a critical point in this country; and the letter on the subject, by Mr. R. G. Skerrett, published in the current issue of the SUPPLEMENT, calls for serious consideration alike in the name of the American inventor, our seaboard defense, and the general development of the rt of submarine navigation. Nearly all of the maritime nations of the earth have given practical recognition to submarine craft. France has gone through all the vexations of thrashing out this subject, and has paid a very heavy price for the lessons she has learned. Next in the importance of the work done comes Great Britain; and after Great Britain, Russia, Italy, Germany, Austria, Norway, and Sweden fall into the order named in the respective importance of their work in this field.

All of these countries have settled upon an even-keel method of submergence for their latest boats. It should be explained that the "diving" or plunging type, to which the Holland boats belong, submerges on an inclined keel, pointing nose downward. The submersible type, as represented by the Lake boats, submerges on an even keel by means of hydroplanes. The undeniable trend in European countries is toward a sea-keeping type of craft of the "submersible" order. This is particularly true of Great Britain, which be an her submarine construction in 1900 by ordering five boats of the Holland design, which were duplications of the "Adder" class then building for the United States navy. These boats were bought as a basis for experiment, and the Secretary of the Admiralty is authority for the statement that, "even before the first Holland submarine w s launched, they had already evolved and laid down what is known as the 'A' type." The accidents that followed among the vessels of this class, and especially the self-impelled plunge of the unfortunate "A8," led the Admiralty to considerably modify the method of submergence when they built the boats of the "B" class. To avoid the initial headlong plunge of the diving type, the British Admiralty fitted hydroplanes on the boats of the "B" class, and were thus able to make the vessel submerge more nearly on an even keel. This feature was improved upon in the boats of the "C" class that followed; and it is said that the vessels of the "D" class will be essentially even-keeled boats. At the same time, the reserve of buoyancy of the British submarines has been materially improved, and their superstructures so increased as to substantially bring them into the submersible class. It will thus be seen that these vessels have radically departed from the Holland type of boats which formed the basis for their development, and it is not correct to liken the British craft to the Holland submarines built or building for the United States navy.

Mr. Francis T. Bowles, when Chief Constructor of

the United States Navy, gave much serious study to the matter of submarine craft, and he informed the Naval Committee of the House of Representatives in 1902 that "most people who studied the submarine boat held the opinion that it is better to change levels while under way by maintaining a level keel, and that would be by the use of what are called hydroplanes." It will thus be seen that Mr. Bowles prophetically anticipated the opinion since confirmed by every European experimenter in this branch of naval architecture.

Apart from the advantages of safety and control thus secured, and aside from the facility with which this system of control can be mastered by men new to the work, the even-keel submergence offers the best lines for development and increase of displacement, because the vessel's length is not a feature that affects the safety with which the boats may be submerged in moderate depths of water. As submarine vessels increase in length and in submerged speed, the risk of striking the bottom head on grows if the vessel must be made to submerge by plunging bow first, and every foot that is added to her length increases the risk, even when a change of trim is made of only a few degrees.

Congress has taken the attitude—so far as the bill recently reporte by the Naval Committee of the House of Representatives may be taken as an index—of favoring still further the diving type of boat; and this in the face of the unanimous opinion in favor of the type which submerges on an even keel which is entertained abroad. It seems to us that the time has come to call a halt in this legislative adherence to one type, and that it is time that the government gave serious consideration to the even-keel type, which has become standard in European practice.

The submarine boat is even yet in the early stages of its development; and now that the government has entered upon the construction of submarines on an extensive scale, we may look for the appearance of yet other competitive submarine-boat builders in the American market. It is only fair to them and to the nation that all of them should be given a fair chance in assisting the country to produce vessels equal to, if not the superior of those being built abroad. Open competition will not only reduce the cost per ton of the boat, but it will act as a spur to the inventive mind, and will enlist the country's best technical skill in a rivalry that must result in national benefit.

We draw attention to Mr. Skerrett's letter in the SUPPLEMENT as presenting the view of one who believes that the field of competition has not been free from the bias of partiality. As to how far he proves his case, it is not for us to say; but the letter is illuminating, as giving a clear view of one side of the present submarine controversy. The facts of the case are, however, in a fair way to be established by the investigation now being conducted by Congress into the charges preferred by Congressman Lilley.

REINFORCED CONCRETE IN SHIPBUILDING.

Strange though this title appears, "the building material of the future" has actually been employed in shipbuilding. In the first Paris exposition, in 1855, a small boat made of reinforced concrete was exhibited by Lambot. This vessel, which was constructed of wire netting covered with cement, is still afloat and will soon be installed in a technical museum. It was regarded as a mere curiosity, and led to no practical result. In 1896 Gabellini of Rome built an experimental vessel of reinforced concrete, which is still in service on the Tiber and in excellent condition. The same firm has since constructed a large number of concrete vessels, designed chiefly for stationary service as bridge pontoons, for which purpose they are eminently well fitted, owing to their small cost of maintenance, as they need not even be painted. These concrete vessels, however, also include boats used in construction work in water and coal barges and lighters having capacities up to 150 tons.

The character of the material and the methods of construction employed with it make it possible to build vessels of reinforced concrete of any desired form and dimensions. The frames and longitudinal beams are made of concrete reinforced with round bars of iron, and the skin consists of a single or double layer of concrete stiffened with wire netting, and made perfectly smooth and watertight by an external coat of pure cement.

Longitudinal and transverse watertight bulkheads, air chambers, etc., can be constructed of reinforced concrete in any desired arrangement. Abrasions and other local injuries caused by collisions with piers, etc., are largely prevented by wooden buffers attached to the hull, and those that occur are easily repaired with cement. The boats cost almost nothing for maintenance, are fire proof, and can be constructed almost anywhere. They cost about half as much as iron vessels of the same capacity. Their independence of regular shipyards makes them especially suitable for colonies and isolated inland waters, as sand is found in most localities, so that only cement and iron —the latter in easily portable pieces—need be transported any great distance.

The use of reinforced concrete armor on warships has recently been suggested. An Italian engineer, Lorenzo d'Adda, has been led by the success of concrete land fortifications, as revealed in the Russian-Japanese war, to construct armor plates of reinforced concrete, covered with thin plates of steel as a protection against the immediate effects of the impact of shells. Concrete armor plates, even when reinforced by stout and closely inlaid iron bars, must obviously be much thicker than hardened steel armor; but as the specific gravity of the material is only one-third that of steel, the weight of the armor need not be increased, while its cost may be very greatly diminished. The substitution of reinforced concrete for steel armor on a first-class battleship would effect a considerable saving. The practicability of the substitution will be decided by the result of experiments, soon to be made, on the effect of shots on the reinforced concrete plates.

HOW TO TAKE ADVANTAGE OF VARIATIONS IN RATES OF GAS AND ELECTRICITY.

Gas rates often vary with the use to which the gas is put, one rate being made for lighting, a lower one for heating, and one still lower for power. Electric rates vary with the use, whether light, heat, or power, to which the energy is put, and also with the time of day when it is taken from the lines. These variations in rates give advantages to those that are able to take them.

In the matter of gas, the rate for power is sometimes no more than one-half of that for lighting. With a gas engine of not less than say 10 horse-power driving an electric generator, one kilowatt-hour may be had at the switchboard for each 30 feet of good illuminating gas consumed. At open burners, under suitable pressure, this 30 feet of gas will yield about 100 candle-hours, or at mantle burners about 400 candle-hours.

The kilowatt-hour developed by the 30 feet of gas, with the aid of an engine and dynamo, will yield 333 candle-hours in three-watt incandescent lamps, or 500 candle-hours in two-watt lamps. In other words, either six open gas jets of about 17 candle-power each, or ten mantle burners of 40 candle-power each, may be supplied for one hour with the 30 feet of gas; or this gas may be used to generate electric energy for about twenty carbon filament lamps of 16 candle-power each, or for twenty tantalum lamps of 25 candle-power.

With the gas at a uniform price for both lighting and power, it may or may not be advisable in any particular case to incur the investment charges and labor expense for the gas engine and dynamo. If the price of gas per thousand feet is only one-half as much when used for power as when used for lighting, then 1,000 candle-hours may be obtained with the tantalum lamps instead of only 400 candle-hours from the mantle burners, and the advantages of the engine and dynamo will be doubled.

In either of the above cases, there will be an advantage in distribution by having twenty electric lamps instead of six gas jets or ten mantle burners.

Rates per kilowatt-hour for energy used by motors are as low as one-third of the rates for energy used by lamps, in many cities, and this makes it possible to get electric light at reduced cost, with the aid of a connected motor and dynamo. For this purpose the motor must take energy from the supply line at the power rate, to drive the dynamo, and this dynamo will furnish current for the lamps.

With an ordinary lighting load for a motor generator of at least ten kilowatts capacity, the generator may fairly be expected to deliver 67 per cent of the energy absorbed by the motor. In a case where the rate per kilowatt-hour for energy used in motors is 67 per cent of the rate for energy used in lamps, the cost of current for lighting is obviously the same, whether it is taken directly from the supply line at the lighting rate or is developed by a motor generator that receives energy at the motor rate.

A rate for energy used in motors only one-third as great as the rate for energy used in lamps will reduce the cost of lighting by means of the motor generator to $33/67 = 5/10$ of that for energy taken directly to the lamps from the supply line. These figures take no account of the interest and labor charges on the motor-generator, but in many cases it will be found that these charges are much less than the saving on the rates for energy.

A large advantage in electric rates can often be obtained by those who are able to limit their demands on the supply system to those hours of the day when the total demand on the system is not at its maximum.

This sort of advantage is strikingly illustrated by the rate at which energy is supplied to several thousand horse-power of motors at an industrial plant in a large eastern city. In this case the rate is 0.57 cent per kilowatt-hour, and to get so low a figure the plant is started earlier than usual in the morning, and stops operations at 4 o'clock in the afternoon, during the winter months, when other loads on the electric supply system are at their maximum.

Another method of shifting the time of day at which energy is taken from a lighting system is the use of a storage battery, which is charged during the night or early morning, and discharged to operate the lamps in the usual lighting hours. Some electrical supply systems deliver energy for charging batteries during the night or early morning at rates that are only one-third or one-fourth of those charged for lighting during the hours of greatest demand. A storage battery will deliver for lighting purposes 80 per cent of the energy used in charging; so that if the rate for charging is as much as 40 per cent of the regular lighting rate, the cost of energy for lighting by means of a battery is only $0.4 \div 0.8 = 0.5$ of what it is if the lamps take energy directly from the line.

THE USE OF THE CINEMATOGRAPH IN MEDICINE.

In the London Lancet Dr. H. Campbell Thomson, M.D., has an interesting note on the use of the cinematograph, which he has successfully used for recording and illustrating the movements of patients suffering from various nervous complaints. The photographs, which were taken at the rate of 16 per second, clearly show the nervous movements, and are used for the instruction of students. Dr. Thomson considers that, given a suitable light, it is possible to take the finest movements and he hopes shortly to be able to demonstrate this by showing the movements which occur during the electrical reactions of muscles.

No doubt ideas will occur to readers in which a record of many medical cases other than those of nervous diseases will be useful, for the whole aspect of a case is often different according to whether it can be seen in life-like movements or only in stationary illustrations. The practice of surgery would also seem to offer great facilities for demonstration by cinematograph, but hitherto little or no serious work has been undertaken for purposes of teaching.

For the general purposes of class teaching in medical and other forms of education there can be no doubt that the cinematograph will prove to be very useful and its management is but little more trouble than that of the ordinary lantern. Moreover, with the most modern types of machine it will be possible to stop at any one picture and thus to combine with the cinematograph all the advantages of an ordinary lantern without any danger of firing the films.

THE CURRENT SUPPLEMENT.

The current SUPPLEMENT, No. 1681, opens with a series of illustrations of Dr. Bell's Man-Lifting Kite. Edward W. Parker contributes a most exhaustive paper on "The Coal Briquetting Industry in the United States." The thirteenth installment of Prof. A. E. Watson's "Elements of Electrical Engineering" makes its appearance. The subject discussed is Principles of Alternating Currents. An article entitled "A New Kind of Wheat," in which the wonderful Durum wheats are described, also appears. The noted physicist Svante Arrhenius has advanced some strikingly new theories based upon the later discoveries in physics. In an article entitled Suns and Nebulæ, published in the current SUPPLEMENT, Prof. Arrhenius shows how nebulæ are formed by the collision of dark suns, how they naturally assume a spiral shape, how the various phenomena which they present may be accounted for by the radiation pressure of the central luminous mass, and how ultimately the chemical constitution of the nebula changes, so that it condenses first into a hot sun, and ultimately into a living world. Dr. Edward A. Ayers writes on the Mosquito as a Sanitary Problem, and considers the various diseases which may safely be attributed to the mosquito.

DEATH OF JOHN BURRY.

John Burry, the inventor of the Burry printing-telegraph system, was asphyxiated by gas on March 12 at his home at Rosebank, Staten Island.

Mr. Burry was born at Friburg, Switzerland, forty-seven years ago. He came to the United States when he was nineteen years old and devoted himself to electrical study and work. His specialty became printing-telegraphy, in which line at his death he was esteemed a great expert. Mr. Burry installed the printing-telegraph plants in Rio Janeiro and Buenos Ayres about twenty years ago. In 1892 he associated himself with the Stock Quotation Telegraph Company.

The world's output of shipping during 1907 aggregated 3,300 vessels, with a total tonnage of 3,221,399. Great Britain and Ireland with 1,571 vessels and 1,724,921 tons (including 51,800 tons warship displacement) produced half of it. Germany comes second in the number of ships with 513, the United States being fourth with 189. In tonnage, however, the United States output ranks next to Great Britain, being 488,340 tons. Germany comes third with 315,584. Japan takes the fifth place, both in number of ships and tonnage.

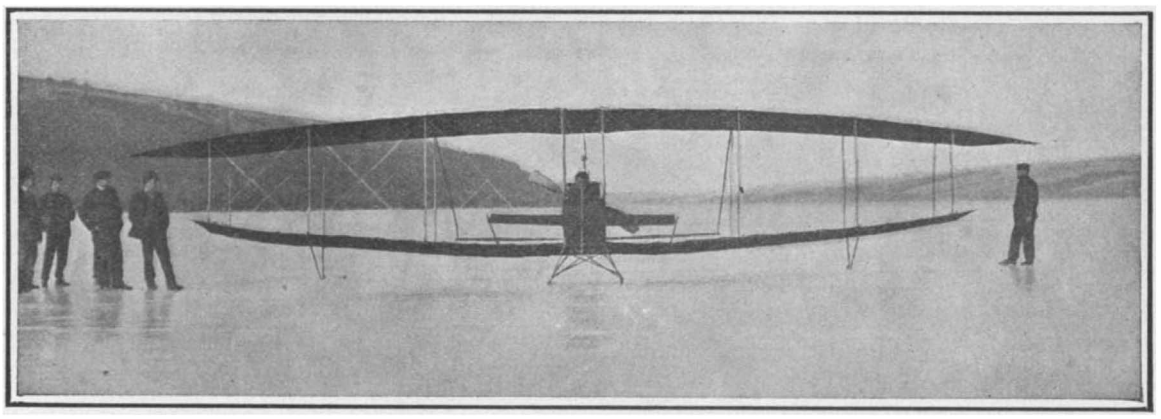
THE FIRST SUCCESSFUL TRIAL OF A NEW AMERICAN AEROPLANE.

The Aerial Experiment Association, which was formed last summer by Dr. Alexander Graham Bell, has been actively engaged during the past three months in constructing an aeroplane. The machine, which is along the general lines of those now being built for the government by Mr. A. M. Herring and the Wright brothers, is shown in the accompanying illustrations. It consists of two superposed surfaces having a spread of 43 feet from tip to tip and a width of 6½ feet from front to back at the center, which width gradually diminishes to 4 feet at the ends proper of the planes. The front edge of the upper plane extends out 4 feet beyond the last vertical connecting posts at each end, and the silk surface tapers back from this edge to the rear edge of the plane, and has several light ribs attached to it to give it stiffness. Thus the planes proper are 4 x 35 feet in size, which corresponds to a supporting surface of 280 square feet, while the flexible rear edges, etc., bring this up to a total of 385 square feet, which is also the weight of the machine fully equipped. Of this, 185 pounds represents the weight of the machine alone, and 200 that of the engine and propeller, filled fuel and oil tanks, etc. Mr. F. W. Baldwin, M. E., who operated the aeroplane in its initial test, weighed 185 pounds, so that the total weight was 570 pounds, or 1.48 pounds for each square foot of supporting surface —a loading that was sufficiently light to make it possible for the aeroplane to rise at a speed of about 25 miles an hour and lift over 20 pounds per horse-power.

In constructing this machine for the purpose of experiment, every effort was made to reduce the head resistance as much as possible, and it was with this idea in view that the planes were curved and brought nearer together at their ends (the spacing apart is 6½ feet at the center and but 4 feet at the ends), so that the connecting posts could be shortened. These posts are somewhat oval in cross-section, their greatest width being from one-fourth to one-third of the distance back from the front edge. The large center posts are 4 inches from front to back and 1 inch thick; the next posts on either side are slightly smaller; and so on to the end ones, which are 1½ inches from front to back and have a maximum thickness of ½ inch.

The surfaces themselves are made of silk and contain pockets, in which are placed the curved, laminated wood strips extending from the front to the rear edge and giving the surfaces their curved form. Above each pair of posts a T-shaped wood strip extends from front to back, and helps to strengthen the structure. The spacing of the vertical posts also decreases from the center outward. The two center posts at the front and rear edges are about 22 inches apart. The first post on either side of these two is 6½ feet away, while the spacing between this and the next post is 5½ feet, and from here to the outer post about 5. The planes are connected together with diagonal guys of the finest piano wire procurable. They are trussed in both a vertical and horizontal direction.

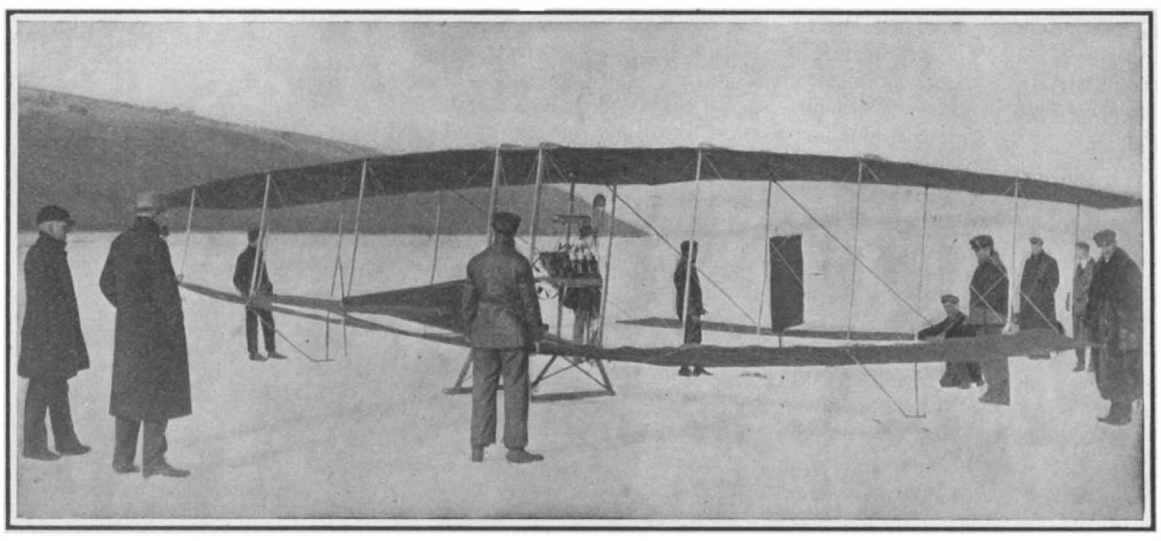
The horizontal rudder, which is 8 feet long by 2 feet wide, is located at the front end of a suitable framework, which projects out 5 feet from the forward center posts. This framework is covered with silk in order to lessen the head resistance. The rudder is steadied at each end by rods, which run back to the planes. It is pivoted on a horizontal axis, and is operated by a vertical lever extending an equal distance above and below it and located at its center. A wire runs from one end of this lever around a pulley in the body framework, and back to the other end of the lever. Attached to the pulley is a small operating lever for turning the same and thus maneuvering the horizontal rudder. This rudder is worked by the left hand of the aviator, while the vertical rudder is operated in a similar manner by a lever convenient to the aviator's right hand. The tail of the aeroplane consisted of but a single horizontal surface located 12 feet back of the rear edges of the planes. The dimensions of this tail were 14 feet 10 inches long by 3 feet wide, i. e., in a fore-and-aft direction. It was carried upon two long bamboo poles, which ran back horizontally from the lower plane, and which were well braced by other bamboo poles extending to the upper planes, and connected to the lower poles by spruce posts. This horizontal tail was also trussed on its under side to a vertical post, upon which was placed the vertical rudder. Despite this trussing, the pressure upward against the tail was so great as to cause it to buckle on one side while the aeroplane was in the air, the result being that the machine veered sharply to the same side and landed, sliding sidewise on the ice and breaking one of the outer runners and its supporting post. The motor employed was an 8-cylinder Curtiss air-cooled engine of 40 horse-power. This engine was mounted on horizontal wood beams connecting the front and rear large center posts. It carried a light bicycle wheel on its front end as a flywheel, while the 6-foot propeller was mounted directly on the rear end of the crankshaft. The pitch of this propeller was 4 feet, and the number of revolutions per minute that it made while the aeroplane was in flight was probably in the neighborhood of 1,200. With the aeroplane held stationary and the motor running, a thrust of 130 pounds was obtained at about 1,000 R.P.M. The lower plane was notched at its rear edge in the center, to allow of the propeller revolving.



Front View of the New Aeroplane, with One of its Designers in the Aviator's Seat, Showing the Propeller, Horizontal Rudder, and Horizontal Tail.

The 40-horse-power motor used had a bore and stroke of 3⅝ and 3¼ inches respectively. This engine develops its full power at about 1,800 R.P.M., while at the speed at which it ran during the flight (viz., 1,200 R.P.M.) it developed only about 25 horse-power. The weight of this engine complete, without accessories, is but 145 pounds, while with a separate carbureter of 14 ounces weight upon each cylinder, and with the combined gasoline and oil tank shown as well as including the propeller, the total weight was but 200 pounds. The engine had been thoroughly tested, driving a propeller and running the motor ice-boat illustrated in our last issue.

The idea of mounting the aeroplane upon runners and testing it upon the ice seems to be an excellent one, and to offer several advantages. Besides the two main runners of substantial construction, the next to the last vertical post at the rear of the surfaces was prolonged downward and fitted with a runner also, for the purpose of steadying the machine and keeping it on a level keel. A runner was also fitted to the vertical rudder post, but was subsequently removed.

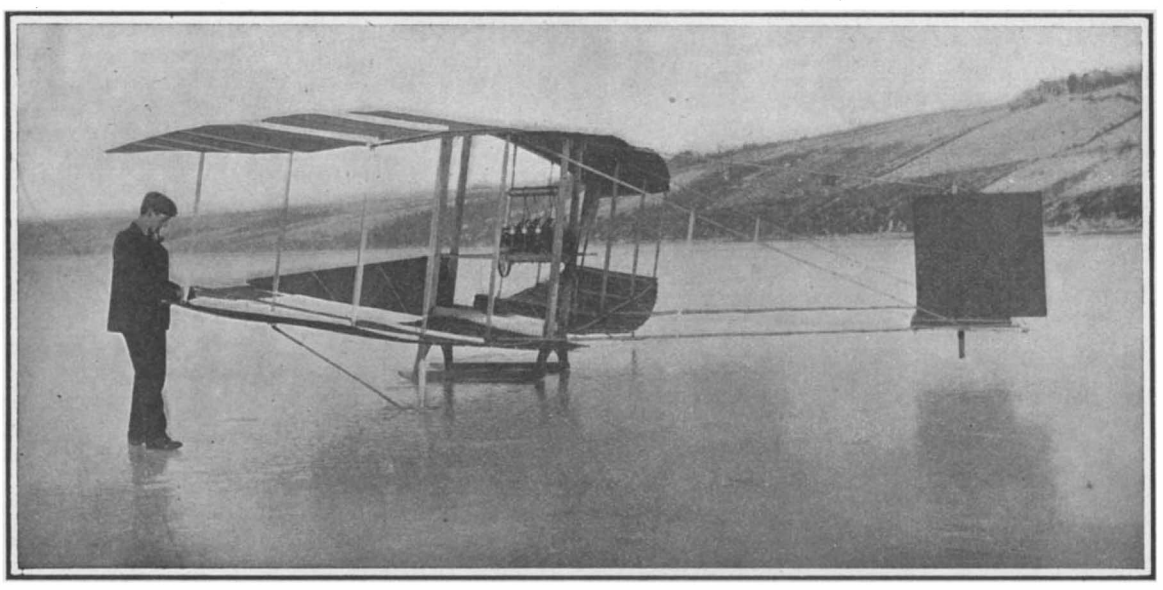


Three-Quarter Front View of Aeroplane, Showing Engine, Propeller, and Both Rudders.

Spread of planes, 43 feet. Supporting surface, 385 square feet. Weight, 385 pounds. Propeller, 6 feet by 4 feet pitch. Engine, 40 H. P., 8-cylinder air cooled.

Owing to the warm weather and the melting of the ice on Lake Keuka, near Hammondsport, N. Y., where the test was held, it was feared that it would be impossible to try the machine. Fortunately, however, a slight cold snap gave the experimenters a chance to make the trial; and on the 12th instant, upon its first test, the aeroplane flew a distance of 318 feet 11 inches, and apparently showed good stability. After running 200 feet, the machine rose to a height of 15 feet, and the trial could have been continued and made much longer had the horizontal tail not been damaged. The chief point to be noted is that no difficulty was experienced in getting up in the air with this machine, and in all probability in the near future it will be possible to make much more extended flights.

The Aerial Experiment Association, and especially those members who have been active in the construction of this new aeroplane, deserve great credit for designing and building a heavier-than-air machine that was able to fly at the first attempt, and we feel sure that in due time some valuable results will be obtained from the systematic experiments being carried on by this association. In the current issue of the Supplement we have published a description of the experiments made by the association with Dr. Bell's tetrahedral kite last fall. While the results were encouraging, it was not deemed wise to attempt to fit a motor to the tetrahedral cell aeroplane, so the latter was discarded for the time being, and experiments were begun with the usual two-surface type of aeroplane, the result being as detailed above.



Side View of Aeroplane, Showing General Arrangement of Engine and Rudders.

The aviator sits at extreme front edge of lower plane and controls the rudders with two small levers within the truncated body.

A NEW AMERICAN AEROPLANE WHICH FLEW AT ITS FIRST TRIAL.

THE LARGEST FRESH-WATER DOCK IN THE WORLD.

BY W. FRANK M'CLURE.

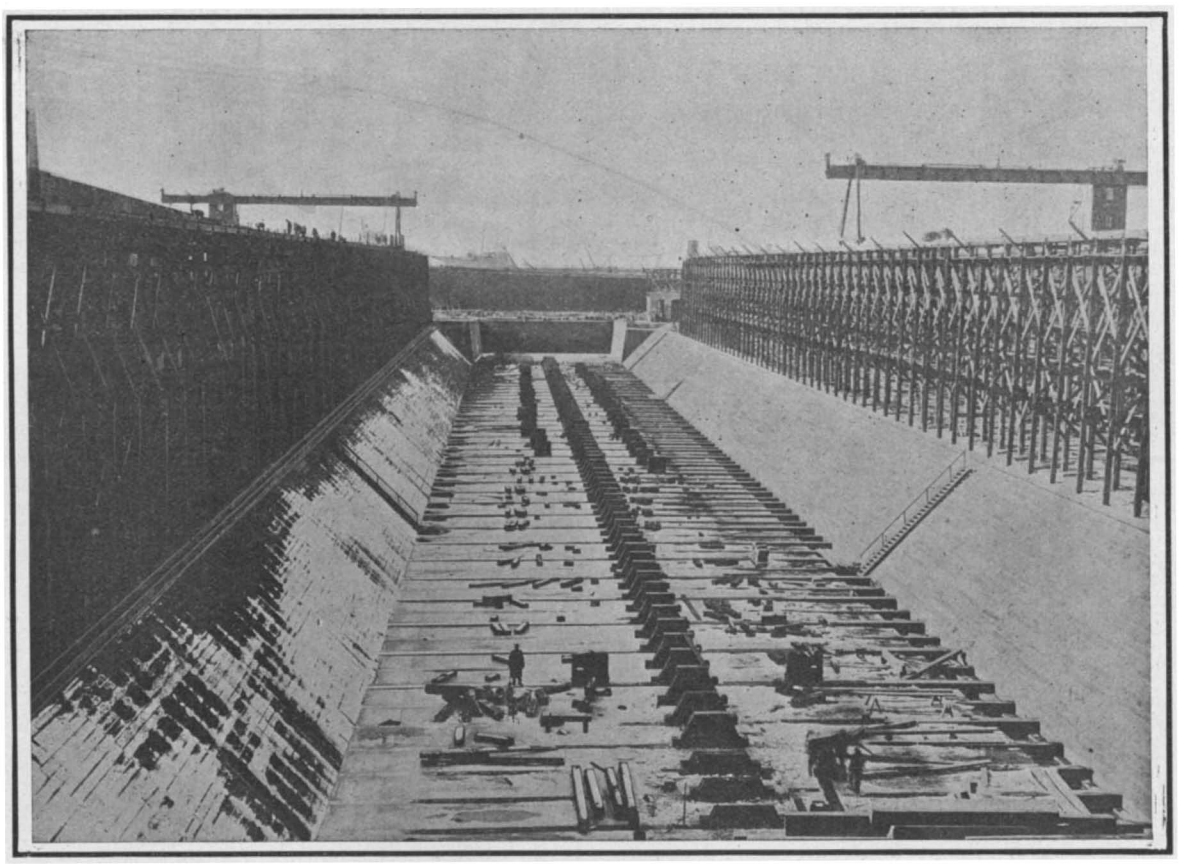
There has recently been completed at Lorain, O., a drydock 745 feet long and 125 feet wide. In spite of the great length to which the vessels of our inland seas have recently attained, this dock is 140 feet longer than the longest ore carrier afloat, and there are but few ocean ships of greater length. The dock is within five feet of being as long as the new drydock of the League Island navy yard, and is easily conceded to be the largest fresh-water drydock in the world.

The length of the dock on the keel blocks is 700 feet. The sloping sides are of 4-inch oak planking, and the cross timbers of 4 x 18-inch Washington fir. Five thousand piles were driven to form the foundations. The gate which closes the river end of the dock is built of steel; it is 82 feet wide, and weighs 110 tons. It abuts on either side on concrete piers and the apron is also concrete. It is pumped dry by a centrifugal pump, which is driven by two 300-horse-power electric motors.

An interesting feature is found in the berths which have been built on each side of the drydock. These admit of the construction of vessels 700 feet long, and the new drydock is so built that it can be used as a slip in which to launch them when built. Great Lake vessels, it will be recalled, are always launched sidewise or broadside instead of endwise as at most coast yards.

When the new drydock at Lorain was first planned, the longest vessel on the Great Lakes was the "Wolvin," length 560 feet. Since then the size has increased to 605 feet, four vessels of this length having been constructed within the past year. It is regarded as probable that a length of 700 feet will be attained in a few years. This rapid development will call for other drydocks of great size. Already one is planned for West Superior, to be built along the same general lines as the one at Lorain. This dock will be equipped with steam pipes, especially arranged to keep the water above the freezing point in the coldest weather.

The new drydock at Lorain is but a portion of the vast shipbuilding improvements being made there by a prominent shipbuilding company. Twenty acres have been added to the area of the plant within the past two years. The river leading to the plant has been enlarged to permit of the passing of the largest vessels, and nearly all the shops have been enlarged. New boiler shops, machine shops, electrical plants, plate-making shops, and other buildings are being erected at a cost of $2,000,000, and when completed will employ in all some 2,100 men.



THE LARGEST FRESH-WATER DRYDOCK IN THE WORLD.

Length, 745 Feet; Width, 125 Feet.

Sterilization of Water by Means of Citric Acid and Sun's Rays.

Dr. Riegel of the Austrian army describes in Archiv fuer Hygiene a number of experiments with citric acid to determine its value as a sterilizer of water. The experiments were made with typhus, diarrhœa, and cholera bacilli. A solution of 0.6 per cent of citric acid and 5 per cent of cane sugar in water was placed in shallow vessels. The cholera germs were killed in 15 minutes; the diarrhœa bacilli were killed in 5 to 6 hours and the typhus in 24 hours. When the vessels were placed in the sun's rays, the action was much quicker; the cholera germs were killed in 5 minutes, and the typhus in 1½ hours.

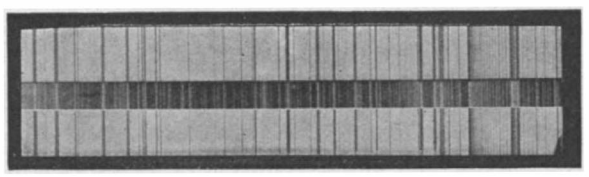
It is therefore probable, says Dr. Riegel, that the use of citric acid in water exposed to the rays of the sun in flat vessels would be of great benefit in countries where the usual sterilization methods (cooking, ozonization) cannot be well employed, as is the case in most of the tropical and sub-tropical countries.

A strange well exists at Riverside Park, Logansport, Ind. An 8-inch pipe was first sunk about 80 feet, and inside it a 5-inch pipe was carried down lower. Fresh water from a limestone stratum comes up between the two pipes, while water which tastes and smells strongly of hydrogen sulphide comes up through the 5-inch pipe from a lower stratum. The sulphur water flows at the rate of a gallon a minute from the drinking fountain over the well, while the fresh water flows with a somewhat smaller volume from a pipe about 20 feet distant.

WATER VAPOR ON MARS.

BY DR. S. A. MITCHELL OF COLUMBIA UNIVERSITY.

A telegram from the Lowell Observatory, Flagstaff, Ariz., recently announced the discovery that the atmosphere of Mars is very rich in water vapor. This information, gained by Mr. Slipher from a comparison of the spectra of Mars and the moon, is one of the most important additions to astronomical knowledge that has been attained in recent years. The solution of the question of water in the atmosphere of the much-discussed planet demands the very best observational facilities and the most careful attention to all the minutest details that make up a delicate research. In short, it may be said that this problem is one of the most difficult of solution in the whole



PORTION OF THE SUN'S SPECTRUM.

Solar spectrum in the center, comparison spectrum of iron at each side.

of astronomy, a science remarkably full of knotty questions. The importance of this latest discovery can hardly be overestimated, for it may almost be said that the whole question of human life on our neighbor hinges on whether the atmosphere of Mars is dry or whether it is saturated with a plentiful supply of the vapor of water; and realizing this, astronomers have been trying now for forty-five years to settle this very problem.

Mars and its canals is all-engrossing to the scientific world at the present time. The near approach during the summer of 1907 has given astronomers after an interval of fifteen years an opportunity to re-attack Mars with improved observational means, especially by the application of the sensitive photographic plate. The Lowell expedition to the Andes for the purpose of photographing Mars was a magnificent piece of scientific research, and Mr. Lowell is to be heartily congratulated upon the success of his photographic work, both in the Andes and in the parent observatory at Flagstaff. The photographs are superb and of excellent definition, and, as a matter of fact, far surpass any that have ever hitherto been taken. Strange as it may seem to the outside world, these photographs have not at all settled the question of the habitability of Mars; for, magnificent as they are in detail, it must not be forgotten that the largest of the Lowell photographs are but a scant three-sixteenths of an inch in diameter, and that no detail is added by putting them under a powerful microscope.

The astronomical world is divided into three over the question of Mars and its canals. On one side we have Mr. Lowell and his followers, who by visual observations with the telescope and the recent photographs have discovered the presence of hundreds of thin line markings aggregating thousands of miles in length. The remarkable straightness of these canals, their systematic arrangement, and the changes that have been noted in their appearance at different seasons, have proved to Mr. Lowell that these canals are the result of human ingenuity, and that their purpose is to irrigate the desert planet and render it fit for human habitation. Conclusive as these arguments seem to be to the observers at Flagstaff, the majority of the first-class astronomers in the world do not agree with them. On the one hand we have the highly-trained observers at the Lick and Yerkes observatories—where the telescopes are bigger than Mr. Lowell's, and where the seeing, especially at the Lick, is probably just as good as at Flagstaff—who have not altogether succeeded in seeing all that Mr. Lowell has seen, though indeed a considerable amount of planetary detail has been observed. And on the other hand there are a great number of astronomers who see thin fine markings when they observe Mars, but who state that they are due to a physiological defect in the eye. This latter idea has been championed by Maunder of England, and lately in a very excellent way by our own Prof. Simon Newcomb. So that Prof. Lowell is practically alone in the astronomical world in believing that he has proven that Mars is inhabited.

Sir David Gill, the former Astronomer Royal at the Cape of Good Hope, one of the greatest living astronomers, after examining the latest photographs of Prof. Lowell, spoke a few days ago in a lecture at the Royal Institute in London in the following manner: "I see nothing even resembling evidence of human work. I do not deny the possibility of the existence of some sort of animal very different from ourselves, but I see no *proof* of the work of sentient human beings on the enormous scale that has been talked about."

Though there is this wide divergency of opinion regarding the canals and their meaning, there is perfect unanimity regarding many features of the ruddy planet. In an exact science like astronomy, the question of the attraction of gravity on the surface of Mars can have only one answer: it is 0.38 that of the earth. All are agreed that Mars is very flat; no mountains have ever been seen by anybody. All astronomers are a unit in believing that there is remarkably little water on Mars, that the dark areas are not "seas" as was first supposed, and that the only water ever claimed to have been seen on Mars is that immediately surrounding the polar ice caps as the snow and ice melts in the Martian summer. In fact, it is this very scarcity of water that makes it necessary to have irrigating canals, in order that life may be sustained. The small attraction of gravity seems in the opinion of all astronomers to demand as a consequence that the atmosphere be very rare, somewhat comparable to that on the lofty peaks of the Himalaya Mountains. Day after day, week after week, the Martian landscape is unobstructed by the presence of any clouds except those of an occasional sandstorm blowing over the barren deserts; no clouds, like those of our own atmosphere, have ever been seen. This absence of clouds and the rarity of atmosphere have most important bearings on the question of life on the planet. If the air at the surface of Mars is as tenuous as that at the tops of our highest mountains, what about the temperature? Should everything then be snow-capped as on the earth? And the temperature below freezing? For this interesting question we have no sure answer, but it has seemed to all investigators that the temperature must be quite low. In addition to the rarity of its atmosphere, Mars is farther away from the sun than the earth, and gets only one-half as much heat. Then, too, Mars is probably an older planet, and, as it is also smaller, has less internal heat than the earth. Looked at from all points of view, Martian weather must be very cold. From theoretical consideration Poynting finds it on the average to be 22 deg. below zero on the ordinary Fahrenheit scale, or 54 deg. below freezing. At this temperature there would be no water to flow in the canals, as the ice would never be melted. Though 54 deg. may be colder than the real temperature, all our knowledge points to the fact that if the

atmosphere on Mars at all resembles our own, it should then be always below freezing. To have water in the canals and above freezing point, it is necessary to assume that the atmosphere differs radically from our own. If with Prof. Lowell we postulate an atmosphere with a copious supply of aqueous vapor, the difficulties of temperature will probably disappear. Water in the atmosphere will act like the glass in a greenhouse, will let the sun's rays in, but will entrap them as they are radiated back, and Mars may thus really have a temperature capable of supporting life. How are we going to discover the presence of this water vapor? It cannot be done by direct telescopic observation. The atmosphere is very rare, and the water vapor for some reason does not seem to condense into clouds. Recourse must be had to the all-powerful spectroscope, which has already settled so many strange problems in astronomy.

The laws underlying spectrum analysis were understood for the first time in 1859, when Kirchhoff explained the meaning of the dark lines in the solar spectrum. Only three years later Rutherfurd of New York and Huggins of London, pioneers in this new astronomy, investigated the spectrum of Mars, in order to see if its red color was not due to great absorption in its atmosphere. Their investigations have been followed by those of Secchi, Janssen, Vogel, Maunder, Campbell, Keeler, and Jewell, men the most prominent in astrophysical research. How has their work been done? And to what conclusions have they come?

As is well known, the spectroscope tells us the chemical constitution of the sun by comparing its spectrum with that of iron, for instance (as is done in the accompanying illustration) and noting the coincidences of the lines in the two spectra. The solar spectrum consists of a bright band of all colors crossed by thousands of dark lines called, after their discoverer, Fraunhofer lines. The principles which enter into the application of the spectroscope to Mars are readily understood. The planet, we know, shines by reflected sunlight. Its spectrum, therefore, must be identical with that of the sun except as it is modified by the (supposed) atmosphere of Mars. The spectrum of the sun would be continuous, i. e., without any lines or breaks, were it not for the comparatively cool layer of gases around the sun, the "reversing layer" as it is called, a sort of solar atmosphere which introduces thousands of dark Fraunhofer lines in the spectrum. Our own atmosphere modifies the solar light which passes through it, and adds to the solar spectrum at least 1,200 lines called *telluric* lines, which constitute what we may term the spectrum of our atmosphere.

The rays of light coming into our instruments from Mars originate in the sun; they enter the atmosphere of Mars, and are there partly absorbed; they are reflected from the planet's surface, and for a second time pass through the Martian atmosphere; and they finally reach us by passing once through our own atmosphere. Each passage through an atmosphere brings additional lines into the original solar spectrum, and thus Mars gives us a very much modified solar spectrum. How are we going to pick out from the enormous number of lines in the Martian spectrum those which are brought there primarily by the double passage through the planet's atmosphere? If we can differentiate these lines from the rest of the spectrum, they will evidently give us the much-sought-for atmospheric constituents. Were it not for the moon, we would be entirely unable to attack this problem. The moon has no atmosphere of its own, and thus if a comparison of the lunar and Martian spectra show added lines in the latter, we should be sure they come from absorption in the atmosphere of Mars—but of this we are not certain until the greatest pains have been taken in the observations, and an infinite variety of detail has been closely attended to. The two spectra may be compared by first looking at one and then at the other, and noting carefully certain lines; or much better still by photographing the two spectra side by side on the same plate, and comparing the spectra at our leisure. But the photographic process is a very exacting one. The prominent atmospheric lines are all at the red end of the spectrum, where the photographic plate rapidly decreases in sensitiveness, and where slight changes are very likely to deceive the astronomer. Then it is very important that the moon and Mars should be at about the same altitude above the horizon, for if the moon were a little lower down in the sky, its light would have to pass through a greater thickness of our atmosphere, to be there absorbed to a greater degree. And as it is water vapor on Mars that we seek, the observations should be made from an observatory located in as high and as dry a place as possible. Flagstaff answers all these requirements remarkably well, with its great altitude above the sea, its dry climate, its powerful telescope, and accurate spectroscope. The Lick Observatory on the top of Mount Hamilton is another ideal location for such a research.

Nearly all the early investigators of the spectrum of Mars thought that its atmosphere very much resembles our own, differing mainly in being richer in water vapor. Shortly after the last opposition in 1892, Prof. Campbell at the Lick Observatory reached the conclusion that the spectrum of Mars is identical with that of the moon, and that consequently nothing is known of the atmosphere of Mars. This opinion was arrived at only after a splendid series of carefully-planned observations with the 36-inch telescope, an instrument whose power is still unsurpassed and placed in a location well suited to the problems in hand.

From a different line of reasoning Mr. Jewell, of the Johns Hopkins University, decides that it is useless to attack this problem until the instrumental equipment is far superior to any that has hitherto been used. Consequently, this seems to be one of the problems for the future to decide; its solution seems unattainable at the present time. The spectroscope settles its problems by the position, character, or intensity of a line or lines among thousands in the spectrum. Marvelous have been its triumphs and wonderful the results attained, such as determining the chemical constitution of the sun or distant stars, measuring the motion in the line of sight of stars millions and millions of miles away, or fixing the nature of the rings of Saturn, but these triumphs have been reached only along a pathway strewn with countless mistakes in measuring the position of a line or in wrongly interpreting its meaning, so that in spectroscopic study it is well to make haste slowly.

As is pointed out by Poor in the "Solar System," a desert planet, barren and desolate, on which life would be impossible were it not for irrigation, but one which is wafted by an atmosphere laden with water vapor, seems to be an anomaly difficult to understand!

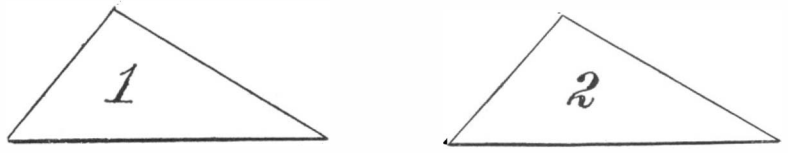


Fig. 1.

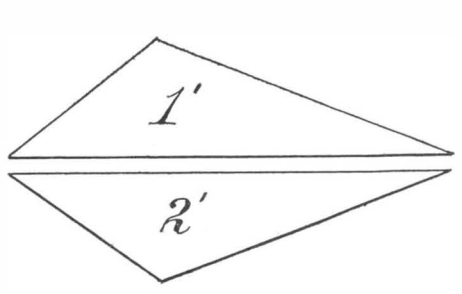


Fig. 2.

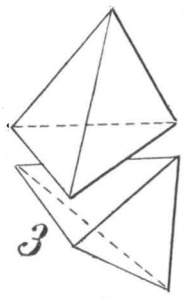


Fig. 3.

A man living in two-dimensional space could bring triangles 1 and 2 into coincidence, but not triangles 1' and 2'. We who live in three-dimensional space cannot superpose the tetrahedrons of Fig. 3; but a man living in four-dimensional space could.

THE FOURTH DIMENSION SIMPLY EXPLAINED.

BY J. SPRINGER.

Reasoning by analogy is always fraught with danger. The premises are insufficient, and so can not lead to conclusive results. But while this is so, it would be quite wrong to speak of well-conducted analogical reasoning as having no intrinsic value. It has a probability of truth in its favor. Such probability may, of course, be very small, and cannot, as intimated, in any case amount to certainty. This, however, constitutes no reason for refusing to assign to it the value it does possess. In addition to any intrinsic demonstrative value it may have, analogy possesses a distinct importance as a scientific guide-post pointing the way in the region of the unknown. And it is this very region that the mind is ever eager to explore. In this article it is proposed to deal with an attempt to fathom the unknowable by means of analogy.

Mathematics is the most exact and the most thoroughly grounded of the sciences. Its processes are, in the main, tedious and prosaic, and its results correspond most severely with our experience. And yet, in the very field explored by this rigorous and tedious method, have arisen fantastic and fairy-like structures of the imagination, which transcend all our experience. It must be confessed that in erecting these castles in the air, mathematicians have let go somewhat the usual rigor of their logic, or have departed from the fundamentals of observation. Thus they have arrived at the conception of the fourth and higher dimensions by a relaxation in demonstration—proceeding by analogy.

Now, in order to understand this question of the fourth dimension, it will be necessary to have pretty clear ideas of what is meant by dimensions in general. Our common units of length—the inch, foot, yard, mile—are examples of what is meant by the expression "one dimension." When I say that a pole is five feet long, I have reference to length alone, apart from all considerations of breadth and thickness. Our experience, it is true, discloses no objects which possess merely length. Still, it is a conception which the mind is capable of realizing by the mental process of abstraction. If we cannot *see* in actual existence a mathematical line possessing neither thickness nor breadth but length alone, we can certainly disregard everything else and *think* of length alone, just as truly as we can think of the color of an orange apart from all considerations of taste, shape, and size. Likewise, we can add breadth to length. We thus have two dimensions—the mathematical surface—examples of which are furnished by our ordinary units of area, the square inch, the square foot, etc. In the world of our experience, there are no pure surfaces existent apart from thickness, but—precisely as with other qualities—we can think of the surface of an object and disregard all else. The existence, moreover, is not imaginary but real. What is imaginary is the *independent* existence of surfaces in the objective world. Again, to length and breadth we may make the further addition of thickness, producing the combination of three dimensions. Examples of this combination are our units of volume—the cubic inch, the cubic foot, etc.

Now these results may be arrived at from a different point of view, and one which will afford us, perhaps, a more general idea of dimensions. The mathematical *point* is the conception of position alone, apart from all other considerations. It has no dimensions. Conceive now that any given point should move. Evidently it will trace out a *line*, either curved or straight. We shall thus have one dimension. Conceive now that this line should move in such a manner that the position continually assumed shall have nothing in common with the position immediately preceding. That is to say, for example, conceive the line *AB* to move in such a manner that the next position is entirely different throughout its whole extent from the old position, and so on. The result of such a motion of a line will be a *surface*—that is, a combination of two dimensions. Now imagine this surface to move, but in such a way that each new position partakes in nothing with the position immediately preceding. We should thus generate a *solid*—that is, a combination of three dimensions. To illustrate this matter, conceive a point to move in a right line for the distance of one inch; then imagine this right line to move, for one inch, in a direction perpendicular to itself. We should thus obtain the square inch. Then picture the square inch moving perpendicular to itself. We have now the cubic inch—a figure of three dimensions. Now, in our world, it is possible to move a point and generate a line, to move a line progressively into new positions and generate a surface, and to move the surface progressively into new positions and generate a solid, but not to take a further step and move the solid progressively into new positions. Our experience stops right here. We live in a space of three dimensions. But mathematics raises the question, Is it necessary to stop here? May it not be possible so to displace a solid that every point will take up a position not included in the old complex of positions? Let us be clear at this point. If I undertake to move, say, an ink bottle, it is evident that a portion of the bottle may easily be made to take up positions not contained in the space occupied by the bottle at first. It is equally evident, however, that, while the whole bottle moves, nevertheless the bulk of the positions taken up are those previously occupied by some points of the bottle. Some points of the bottle have gone into perfectly fresh positions—others have gone into old. Our experience, then, knows nothing of a solid moving continually into an entirely fresh position. But is this the termination of the world of reality? We cannot say, positively, that it is. We can say that we can image to ourselves no such thing as motion in a fourth dimension. It would be absurd, however, to limit reality to what we can picture or represent to ourselves. To bring this into relief, we may imagine to ourselves the feelings, ideas, and life in general of beings confined to worlds of one and two dimensions.

Conceive, then, a world of one dimension—say the circumference of a circle. Unless the inhabitants of this world are mere points, they are arcs of this circle. And the objects in such a world would consist of points and arcs. No other figures or shapes would be possible. In fact, the only difference in figure would be in the amount of arc. If we further suppose that the qualities superadded to those of geometrical figures are such as—analogously to what is the case in our world—would prevent two from

occupying the same space at the same time, then we readily arrive at the conclusion that no two individuals or objects could pass each other in that world. An individual living there would thus make the acquaintance of but two things during the entire course of his life—the object or fellow-inhabitant ahead and the one behind. There could be no food taken into the interior of such an individual. The only possibility of growth would be by the addition of arc to arc—no assimilation of the particles of food throughout the organism, nothing but a bodily attachment, end to end. His geometry would be limited to points and arcs. No straight lines, angles, triangles, parallelograms, and so on. In arithmetic, he would seem to be conscious of but one complete whole—that is, himself. For the other two objects are not present to his senses as wholes. He is conscious only of an extremity of each. So, then, he would appear to rise no higher than the number *one* in his numerical calculations. If, in his world, there should be something analogous to light, it would not seem to afford him means for the estimation of distance—there would be no visual angle. Light would proceed in a curve along the circumference, and while he could see the individual ahead, he could not become sensible of any variations in the distance between them—there being but one ray of light possible, there would thus be no intermediate states. A collision would take place with absolutely no warning. Apparently, it would be impossible to become conscious of motion. It would seem to follow from this, then, that there would be no apprehension of time. But these limitations would certainly be no conclusive argument for the nonexistence of space of higher dimensions with their increased possibilities.

Beings in a world of two dimensions—say, on the surface of a plane—would enjoy an increased variety, but would still be leading a rather restricted life. Objects would appear to them simply as lines. They could pass each other, and could congregate in cities, etc. They could have means of transportation, but the vehicle body would partially or entirely surround them, and convey them over the surface by dragging. There would be no surface friction, so, perhaps, this would not be disagreeable. There would be no leap-frog, foot-ball, or any other game where one body is required to pass over another. A material closed curve would be sufficient to confine them. They could not understand how it would be possible to escape by passing out into a third dimension—above or below. If they studied geometry, they could prove equality by bringing into coincidence two such triangles as 1 and 2, Fig. 1. But if they were given the triangles 1′ and 2′, Fig. 2, they could never bring them into coincidence. They could not understand how by suitably placing two equal sides in coincidence, the one triangle could be swung out into a third dimension and brought back into their world of two dimensions with its parts arranged in opposite order. But their failure to understand the possibilities of the third dimension would be no conclusive argument, certainly, against its existence.

So, then, we may very well argue that the existence of a fourth dimension may be a fact. If such a dimension exist, it would be possible for us to pass into it and become immediately invisible to those conscious as we now are of but the three dimensions. For passing into the fourth dimension, we should pass out of our present world. It would be impossible to confine a person having the secret of this dimension by the six surfaces of a prison cell. His slightest movement in the direction of a fourth dimension would put him at once out of three-dimensional space. It would be well for him to take care just what he did when in four-dimensional space, as upon coming back into space of three dimensions he might be much changed. It will be remembered that when one of the triangles in Fig. 2 was turned about in three-dimensional space, its parts were found to be reversed when it re-entered space of two dimensions. Analogously, we would reason that the tetrahedrons of Fig. 3, while not superposable in our space—although all corresponding parts are supposed equal—might become so if we should bring two equal faces into coincidence, and, while retaining them in this position, turn one of the tetrahedrons through four-dimensional space back again into our own. This would show that a person might so turn over in that variety of hyper-space that when he returned to ours he would find himself reversed—appearing as he does in a mirror, with right and left, front and back, interchanged. The idea immediately suggests an H. G. Wells story.

The writer remembers reading a story somewhat to the following effect: A gentleman drew up designs for a new clock, and had made upward of $30,000 worth. These clocks were excellent timekeepers, but through some error, perhaps in blue-printing the drawings from the wrong side of the linen, the clocks had their hands turning in the wrong direction. With knowledge of the fourth dimension, they could have easily been reversed, which shows that there may be some practical good in living in four-dimensional space.

Correspondence.

The Parsons Marine Turbine.

To the Editor of the SCIENTIFIC AMERICAN:

In your article in the current issue (February 15, 1908) on "Turbines in the United States Navy," there is at least one statement that is contrary to fact, and several others which are misleading to anyone who has had no experience with steam turbines. The article seems to me to be unjustly derogatory to the Parsons turbine, and to give more credit than is due to the Curtis, a practically untried turbine for marine work. While wishing to see the American type prove superior to the English, still I feel that it is unjust not to give the Parsons turbine credit for the revolutionizing of marine engineering which it has brought about. Until data are given out as to the "Creole's" fuel and water consumption, and until the scout cruiser "Salem" is given a trial, undue praise of the Curtis turbine should be withheld.

Your statement that the length and displacement of the five 800-ton destroyers had to be increased to provide for Parsons turbine installation is contrary to fact. The writer personally worked on the designs which were accepted for two of the boats. Parsons turbine machinery, including the necessary cruising turbines, was fitted into the Department's hull, and not only was it possible to shorten the engine-room space taken up by the reciprocating engines, but less space was taken up vertically, the center of gravity of the machinery was lowered, and the total weight of machinery was less. Hence your statement that the action of the authorities in accepting Parsons turbine installation for these destroyers "seems illogical in view of their refusal to accept Parsons turbines for battleships," is rather misleading. In the first place, as has been shown, Parsons turbines for this design were vastly superior to reciprocating engines. In the second place, it does not follow that since the design of the "South Dakota" and "Delaware" was unsuited to Parsons turbines (about which more will be stated later), every battleship design will be. There was no trouble in fitting this turbine to the "Dreadnought" design. Also, no comparison between a battleship and a destroyer is possible or logical, since the conditions are radically different.

While the initial cost of turbine machinery when cruising turbines are necessitated by low-speed requirements may be greater, still the saving in coal and water practically eliminates the initial cost consideration. We might as consistently argue that condensers are a disadvantage, since the installation would cost less were they omitted. Cruising turbines seem a positive necessity, and the makers of the Curtis turbine have yet to demonstrate that they can run at low speeds economically, i. e., that they themselves do not need cruising turbines.

The economic speed of any turbine bears a certain ratio to the steam velocity. If the speed drops below this, the economy falls away. The economy of the cruising turbine really consists in providing for a more effective utilization of the low-pressure steam as expanded into the ordinary ahead turbines.

Cruising turbines do not necessarily make an installation "unwieldy and complicated," although there is a slight complication of connection and arrangement. To anyone who has seen a turbine engine-room when the machinery was in operation, with the freedom from noise, escaping steam, waste oil, flying cranks, piston rods, levers, etc., unwieldiness and complication seem terms applicable only to a reciprocating engine. Also, as stated above, a five-turbine, three-shaft Parsons turbine installation for high speeds occupies less space and weighs less than a reciprocating engine installation of the same power. The extra shaft, if anything, is an advantage, since if one shaft were disabled, the vessel would still be able to make good speed with the other two shafts.

It appears that outside of the face of the bids, one reason for not accepting Parsons turbine installation for the "South Dakota" and the "Delaware" was that the design would not accommodate the number of shafts necessary. It is to be hoped that it will not be found necessary to remodel the "South Dakota" when it becomes necessary to add cruising turbines on separate shafts to the Curtis installation, in order to bring the coal consumption at slow speeds down to something reasonable.

Having also seen something of the working of the Bureau system, it seems absurd that the action of the Japanese government in ordering two sets of Curtis turbines could have influenced the awards of the "South Dakota" and "Delaware" contracts. If it were the department's custom to accept advice from anyone, or to be influenced by the action of foreign governments, it would seem to be the consistent thing for them to follow the action of the English and the French governments, and adopt Parsons turbines.

You rightly attribute the breaking of the transatlantic record by the "Lusitania" to the use of Parsons turbines, and rightly state that considerations of weight, and space occupied, are not of prime importance in a merchant vessel. But it has been shown that Parsons turbines require less space, and weigh less, than reciprocating engines of the same power. This is true of the "Mauretania" and the "Lusitania." To bring the matter nearer home, each of the two Curtis turbines of the "Salem" weighs almost as much as all six of the Parsons turbines of the "Chester." Furthermore, it has been shown that the problem of designing reciprocating engines for the "Lusitania" and her sister ship would have been stupendous, if not impossible.

Finally, Parsons turbines are now installed in torpedo boats, private yachts, merchant vessels, cruisers, and battleships, and have proved superior to reciprocating engines in many particulars. A few of these may be of interest. Fewer working parts; direct application of steam to the shaft; less danger of breakdown, since it is almost impossible for the small vanes to become damaged; less weight of machinery for same power; machinery well down in vessel, hence a lower center of gravity; greater speed for the same consumption of coal at high speeds; practically no machinery vibration.

To date, the Curtis turbine has been installed in but one small merchant vessel, the "Creole," and data as to the performance of the machinery of this vessel would be, if such data are obtainable, very gratefully received. Also, there will be an opportunity soon to publish comparative results of the performances of the "Chester," "Birmingham," and "Salem." The "Chester," equipped with Parsons turbines, has just made 26.52 knots on her official four-hour run, and has bettered her required coal consumption by 53 per cent. The writer had the privilege of being on board during the builders' trial, and too much praise can not be given to the Parsons turbine. The Curtis turbine has yet to prove its value for marine purposes.

Bath, Me., February 20, 1908. V. H. PAQUET, S.B.

A UNIQUE SYSTEM OF ILLUMINATION FOR HARBOR CHANNELS.

The question of harbor navigation by large vessels at night is a serious one at best. The usual lights designed to guide the vessel are too few and far between, and when they are obscured by fog the task of the pilot is a hopeless one, and highly dangerous. Realizing the advantages to commerce of illuminating the New York harbor so that it could be navigated at night, the Lighthouse Department has recently installed a series of buoys along the Ambrose Channel, fitted with gas lamps, which serve as lamp posts along the highway of the harbor. The lamps are provided with sufficient gas to keep them burning night and day for a month. They need no attention unless injured by collision with some vessel or by the force of the waves.

A new system of illumination has recently been proposed, in which the lamps instead of being placed above water are situated along the bed of the channel, and are arranged to direct their light to the surface, where the outline of the channel may be traced by illumination of the water. By placing the lamps under water they furnish no obstruction to navigation of smaller vessels, which are not obliged to follow the deeper channels. They can also be placed low enough to clear the bottoms of the largest vessels as well.

A cable is laid along the channel, preferably one at each side of the channel, and at intervals along this cable the lights are attached. These consist of tubular buoys provided with a lens at the upper end and fitted with an incandescent electric lamp inside, the light of which is focused by the lens in a vertical shaft, which rises to the surface and illuminates a patch of the surface water. The lamps are supplied with current from a dynamo or battery on shore, where they are under the control of an operator. Following the usual custom, one side of the channel will be outlined with light of a different color from the opposite side. These lights could be placed at much more frequent intervals than the usual buoys. However, experiments conducted by the inventor, Mr. Léon Dion, point to the fact that three or even two per mile would be ample in a straight channel. The cables can be securely anchored to the bottom but the lamps, owing to their flexible connection with the cable, will be free to sway slightly with the motion of the water. The buoyancy of the lamps is merely sufficient to hold them upright and not strain the main cable.

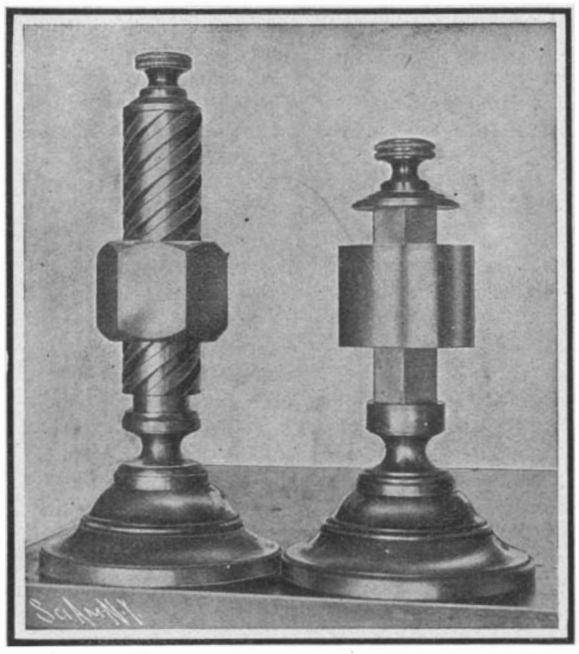
When repairing the lamps or replacing burned-out globes the cable may be lifted by a grapple. However to facilitate matters the lamps may be separately anchored to the bed of the channel and be connected to the main cable by connections long enough to permit them to be raised to the surface. Repairs could then be effected without disturbing the main cable.

The submerged lights would have an advantage over surface lights in serving as guides to submarine boats when maneuvering in the harbor. In time of war the lights would be switched off under normal conditions but whenever desired they could be turned on at a moment's notice to admit a friendly vessel.

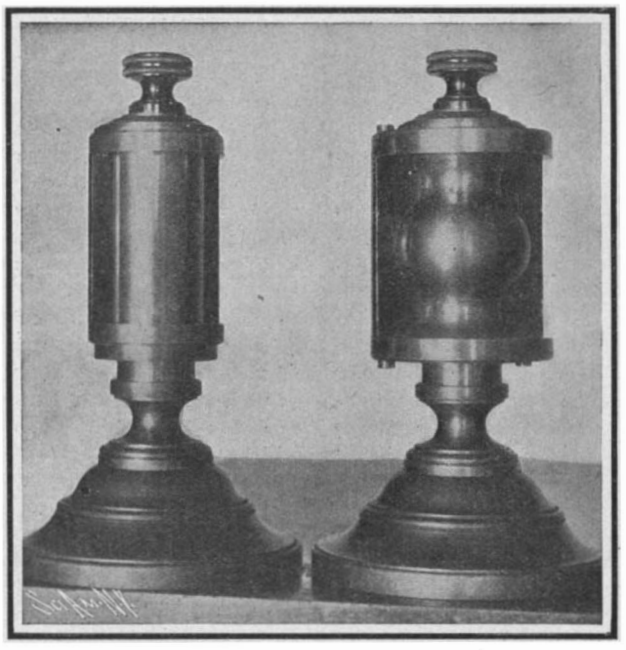
THE MUTUAL RELATIONS OF GEOMETRY AND MECHANICS AND PROF. REULEAUX'S MECHANICAL MOVEMENTS.

BY DR. ALFRED GRADENWITZ.

It is a strange fact that the fundamental principles of a science should be frequently misunderstood, even by the very workers in its field. A similar misunderstanding can be observed even more frequently in the case of the interrelations of kindred sciences. It may be said that those existing between the sciences of geometry and mechanics have but recently been first elucidated, notably by the late Prof. Reuleaux of the Charlottenburg Technical High School, to whom we are indebted, not only for a clear definition of the relations of these sciences and their various branches, but for the evolution of a new science called kinematics, which is an offspring of both of them.



Figs. 1 and 2.—Elementary Couples: a Couple of Screws and a Couple of Prisms.



Figs. 3 and 4.—Elementary Couples: Couples of Rotary Bodies.

Mechanics may be defined as the science of the causal relations between the motions of bodies. It is thus an experimental science. Its most simple, ultimate fundamental law, derived from experience, is the law of inertia, according to which any individual material point in the absence of any force will continue its local displacement by a uniform motion in a straight line. The science of mechanics then demonstrates what happens when this material point comes into relation with other points. While even in the simplest case of a rectilinear displacement of a single point, the trajectory, viz., the straight line, comes within the field of geometry, the same is true generally of the path traversed by the point under the influence of external attractions and repulsions, this path being a curve, and under certain simple conditions a conic section.

As the form of this trajectory is thus subject to geometrical consideration, the more so as it becomes more complicated, geometry soon becomes a most indispensable aid to the science of mechanics. Being itself independent of matter, it does not rely on any reciprocal aid on the part of mechanics. And as on the other hand there are many mechanical problems, e. g., those relating to liquid and gaseous bodies, in which geometrical considerations are not resorted to, mechanics is not entirely dependent on geometry.

From the two fundamental sciences mentioned have originated in course of time two sub-sciences, viz.:

The geometry of motion, from general geometry, and the science of kinematics, or mechanics of guided motions, from general mechanics.

The geometry of motion comprises the geometrical study of the various forms of motion, while the science of kinematics treats of mechanical systems, where motion is subject to some restraint.

A very familiar instance of the geometry of motion is the theory of cycloids, or the curves described by a circle rolling on another circle situated in its plane. This science thus treats of moving figures each of which is a particular case arising out of an infinite group of figures as described by the various points of rolling curves. In opposition to the planimetry of old, which merely considered a given resting curve, this geometry thus studied a curve performing a relative motion in regard to another (resting) curve, all positions of the describing points being expressed by equations. This has also been termed phoronomy.

However, when examining the several forms of cycloids, it will be seen that there is no necessity for maintaining the old theory, according to which, one of the curves would be at rest, and the other in motion. In fact, this is an accidental rather than essential characteristic, as the same figures will be described in the case of two rolling curves, which perform a relative motion with regard to each other, but situated, not in the drawing plane, but in the plane of one of the curves, and being described by the points in the plane of the other curve.

It will be readily seen that the relative motions of two curves rolling on each other are entirely equivalent; in fact, both are bound always to coexist, neither of them being susceptible of independent existence. If accordingly two curves A and B, rolling on each other, be given, both the rolling motion of A on B and that of B on A should be taken into account, in order to establish the geometry of their relative motions. By this theory, the number of special cases is reduced to about half the original number.

A very striking instance quoted by Reuleaux is the

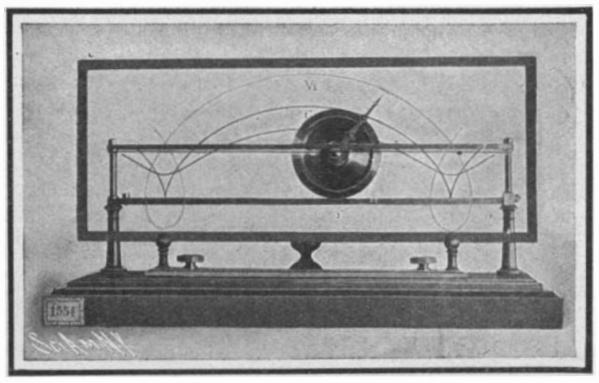


Fig. 5.—The Generation of an Ortho-Cycloid.

relative motion of celestial bodies. From the point of view of the geometry of motion it is as true to state that the earth revolves round the sun as it is that the sun revolves round the earth. In fact, the whole depends on a displacement of the system of co-ordinates. Both the partisans of the old cosmical system and those of Copernicus', Tycho's, and Keppler's systems were thus right, as all astronomers prior to Newton had considered the motion of astres merely from the point of view of phoronomy or geometry of motion, regarding a given motion merely as a phenomenon. Only from the point of view of mechanics (viz., the science of *causal relations* between motions) can any preference be given to the views held by Copernicus and Keppler. In fact, half a century after Keppler's death, Newton proved that planets, under the action of general gravity, perform their motions as ascertained by Keppler. The science of nature thus made an enormous advance, as Newton's law comprised the whole of the universe. The mutual relations between the sciences of geometry and mechanics are strikingly illustrated by this instance. While the merely geometrical researches of Keppler prepared the way to Newton's mechanical discoveries, the science of mechanics reciprocated for the service rendered it by geometry by reducing the three Keppler laws to a common cause, viz., that of the causal connection of motions. From the point of view of phoronomy the relative motions of celestial bodies, not only apparently but really are of extreme variety, their trajectories being alternately elliptical, cycloidal, ellipto-cycloidal, cyclo-elliptical, whereas the planets from the point of view of mechanics are revolving round the central body in elliptical trajectories or more generally in conical sections, with or without a rotation of the revolving and central bodies.

After defining the mutual relations between mechanics and geometry, a scientific definition of kinematics should be given, the more so as the position of the latter in regard to the two former sciences has been greatly misunderstood.

Among the numerous phenomena of mechanical nature, the causal relations of which come within the field of scientific mechanics, are the phenomena of motion occurring in machines. These motions in so far differ from other phenomena of motion, as they occur in a predetermined manner, though there are forces tending to disturb these motions.

Endeavors to investigate the laws of these motions in a scientific manner were first made about a century ago, but nothing really practical had been achieved previous to Reuleaux. While being taught in technical schools, this doctrine in the absence of any theory was of little practical use to inventors.

The fundamental principle of Reuleaux's theoretical kinematics consists in supposing all parts of a machine endowed with sufficient resistance to undergo only immaterial alterations under the action of given forces. The mechanism thus becomes independent, to some extent at least, of the magnitude of forces, its resistance being sufficient, no matter how great the forces acting on the machine parts actually are.

The subject of Reuleaux's kinematics now is to demonstrate the laws of guided motions. Guided motions are performed by a mechanical system subjected to some restraint, the resistance and form of the machine parts coming into contact being such as to preclude all relative motions except one. If, then, this mechanical system be made to move, its motion necessarily is the only possible motion as regards its trajectory, while its speed depends on the acting forces.

Kinematics now teach the special arrangements of a machine, in virtue of which the mutual displacements of its parts are determined. While inventors and engineers so far have evolved the most various types of machines without the aid of any theoretical principles of this kind, these theories will allow new machines to be designed far more rapidly and more easily and safely than heretofore.

As the various parts of a machine mutually act on one another, there must be a similar theory to that

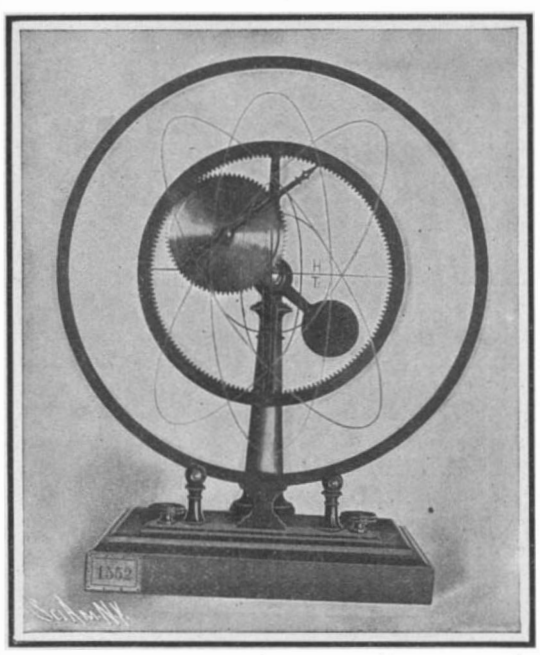


Fig. 6.—The Generation of a Hypo-Cycloid.

Fig. 7.—The Generation of a Peri-Cycloid.

above demonstrated in the case of geometrical curves rolling on each other, that is to say, *all parts* of the machine *must be arranged in pairs.* In fact, all machines, as shown by Reuleaux, consist of pairs of elements called *kinematical element couples.*

These elements are of three kinds, namely, *rigid elements, tension elements,* and *thrust elements,* according as they oppose sufficient resistance either to forces of any direction or only to tension or thrust respectively.

Among the rigid elements should be mentioned shafts, spindles, pivots, bearings, screws, nuts, etc., made of iron, steel, or other resistant substances.

Tension elements comprise threads, ropes, bands, belts, wires, chains, etc. These are preferably coupled with rigid elements, from which they are wound off, as for instance in the case of pulleys. However, they are also coupled with each other.

As regards thrust elements, these are represented by liquids, gaseous substances, and powdered, grainy, or pulpy matter, and are preferably coupled to rigid elements, viz., vessels and parts of such, while mutual couplings of thrust elements (e.g., air with water) are likewise used. As the alterations in shape undergone by thrust elements under the influence of external forces generally are not negligible, these elements are not as a rule susceptible to phoronomical consideration.

The Technical High School of Berlin-Charlottenburg possesses a special department, comprising extensive collections of models of such elements, the study of which is most instructive to the student and engineer. In fact, by combining such mechanisms (the laws of motion of which are derived from the science of kinematics) *the art of machine construction can be systematized, and machine invention, so to say, can be carried out to order.*

The writer is indebted to Prof. W. Hartmann, the friend and collaborator of Prof. Reuleaux and present head of the Kinematic Department, for courtesies extended to him in preparing this article. The accompanying illustrations were reproduced from photographs especially ordered by the Professor, with a view to their publication in the SCIENTIFIC AMERICAN.

Figs. 1 to 4 represent what are called elementary couples of machine elements or couples of involvents.

Fig. 1 represents a couple of screws, Fig. 2 a couple of prisms, and Figs. 3 and 4 couples of rotary bodies, Fig. 3 being relative to a couple of cylinders.

Each of these couples comprises two elements liable to perform only one given relative motion with regard to one another. These couples of elements are called couples of involvents, because of their touching each other along a full surface.

Figs. 5, 6, and 7 illustrate some instances of the generation of *cycloids* by real motion through guided mechanisms. Fig. 5 shows the generation of an orthocycloid, the rolling circle being compelled by bands actually to perform a rolling motion, as the bands will prevent the rolling circle from sliding.

Fig. 6 represents a case of a hypo-cycloid, the ratio of the rolling circle to the stationary circle being 1:2. Each point of a plane connected to the rolling circle describes an ellipse, while the points of the circumference of the rolling circle describe diameters of the stationary circle, which according to Reuleaux are what are called *rectilinear ellipses.*

Fig. 7 illustrates the generation of a peri-cycloid, being the reverse of the previous example, the larger circle rolling round the smaller one, so as to produce curves called *cardioids.* Several such cardioids are shown in the figure.

Figs. 8 and 9 are instances of the presence of polar trajectories (rolling trajectories) in each plane mechanism. Fig. 8 shows as fundamental mechanism a symmetrical anti-parallelogram, the polar trajectories being hyperbolas, and each point of the moving system describing, according to Reuleaux, a cyclonoid in a resting system.

Fig. 9 deals in a similar manner with an isosceles crank gear, the curves generated by the rolling motion of the polar trajectories being likewise cyclonoids. Fig. 10 represents a case of a conical rolling motion, viz., the generation of spherical evolvents. The circular disk placed obliquely in the figure is rolling on the stationary cone. Each point of the circumference will generate an evolvent of the kind represented to the left, while any other point generates an elongated or shortened evolvent. The index of the rolling disk points to such a spherical evolvent of the elongated type.

Fig. 11 is an instance of the construction of curve thrust models, viz., a globoidal thrust as Reuleaux would term it. On being turned by means of the handle through the intermediary of a conical pair of wheels, the globoid will drive the cam, which is acted on permanently by a spring. In order to produce by the aid of these kinematical element couples a given motion in space, one of the elements should be fixed. The element being fixed can be exchanged; the couple is thus reversible.

Fig. 8.—The Generation of a Symmetrical Anti-Parallelogram.

Fig. 9.—The Generation of an Isosceles Crank Gear.

However, these kinematical element couples will mostly occur in machines, not singly but in special connections called *kinematical chains.* In a simple kinematical chain, each element of any couple is rigidly connected to one element of another couple; each link of a chain thus comprises two elements of different couples, and the chain has as many links as couples. The chain may be such that each of its links is susceptible only to one relative motion in regard to each one of the remaining, in which case it is called *guided in itself.* If, now, one of the chain links be fixed in space, the relative motions of the movable links will pass to what is called absolute motions, that is to say, *the whole will become a mechanism or gearing.*

Fig. 10.—The Generation of Spherical Evolvents.

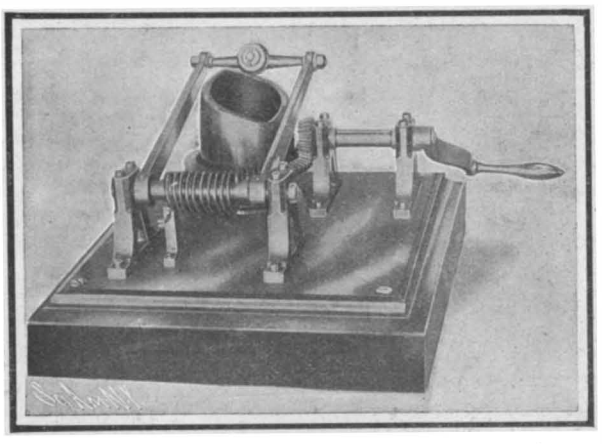


Fig. 11.—The Construction of a Globoidal Thrust.

THE MUTUAL RELATIONS OF GEOMETRY AND MECHANICS.

Such kinematical chains thus yield as many mechanisms as they comprise links. By exchanging the fixed link, a reversal is produced. By combining or composing simple kinematical chains, "composed" mechanisms or gearings can be obtained.

Invisible Microbes.

When one speaks of microscopic beings, it must be remembered that there are all kinds of microbes. They are of all sizes, and reducing sufficiently the scale of measure, one finds in this world of the infinitely small, both the elephant and the gnat. Bacilli of relatively colossal dimensions are known. The bacillus Butschlii, for example, which measures from 3 to 6 microns in length (3 to 6 thousandths of a millimeter) is a giant beside the grip bacillus, which in size is not more than ½ thousandth of a millimeter. This last bacillus, so widely known and so dangerous, is one of the smallest measured microbes, and if there should be found creatures of dimensions five sizes smaller, the limit of visibility for microscopic objects, which is 1-10 of a micron, would be reached. This limit has been reached and overstepped in the infinitesimal sense, by the Liliputians of the microbe tribe, which have received the name of invisible microbes.

The first typical work relating to invisible microbes dates from the year 1898. They have to do with the aphteous fever, which has been shown, particularly in the last few years, as one of the most deadly epizootics. If one examines with the naked eye a drop of serum containing some of these characteristic aphtics, which in times of epidemic so easily invade the mouth cavity and all the mucous membranes of bovines, it would seem at first that this liquid is perfectly clear; but under the objective of the microscope, it seems to be peopled with bloody globules and refracting granulations. Until the present time it has always been impossible to dissociate these granulations of such a vague form, and to classify the extremely small organisms of which they are no doubt formed.

That which is well known, at any rate, is that the aphteous serum diluted in sterilized water and filtered over a Berkefeld funnel of infusorial earth preserves its entire virulence. When calves are inoculated with it, this filtered virus communicates to them the aphteous fever. It is thus legitimate to suppose that the virulence is due to a very small microbe, capable of traversing the very small openings of the filter. A number of other microbes are in the same class. The microbe of bovine peri-pneumonia constitutes, one may say, a stepping stone between the bacteria which are easily seen with the microscope and the ultra-microscopic bacteria, since it can be seen under very high powers. It goes through the Berkefeld filters of infusorial earth and through the Chamberland cone of permeable type, but is stopped by the Chamberland cone of less permeable form.—Cosmos.

A Relic of Early San Francisco.

A relic of the old time when "the water came up to Montgomery Street" has just been unearthed in San Francisco. In the old days of '49 the ships which called at Yerba Buena—as San Francisco was then called—found themselves stranded, for the crews would desert *en masse* for the gold diggings. More than one captain, seeing the hopelessness of getting a crew, followed his men in the hope of washing out a fortune. These derelict ships were soon "stranded" in a double sense, for the land encroached, or was filled in, seaward, and the ships gradually became hotels on dry land. Among these ships was the "Niantic," built in a Maine shipyard of Maine pine, or bull pine as it is called in California. After being deserted, the ship was pulled ashore at Clay and Sansome Streets and converted into a lodging house. The shallow water at her stern was gradually filled up with sand brought from the neighboring streets and the "Niantic" became a fixture on the land. After many years the Niantic Block, one of the best constructed buildings of the early days, was erected over her timbers. The Niantic Block perished in the conflagration of April, 1906. Recently, in digging the foundations for a new Niantic Building, the keel and ribs of the old ship were found fast in the mud and sand.

PHOTOGRAPHS WITH TAPESTRY EFFECTS.

BY GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

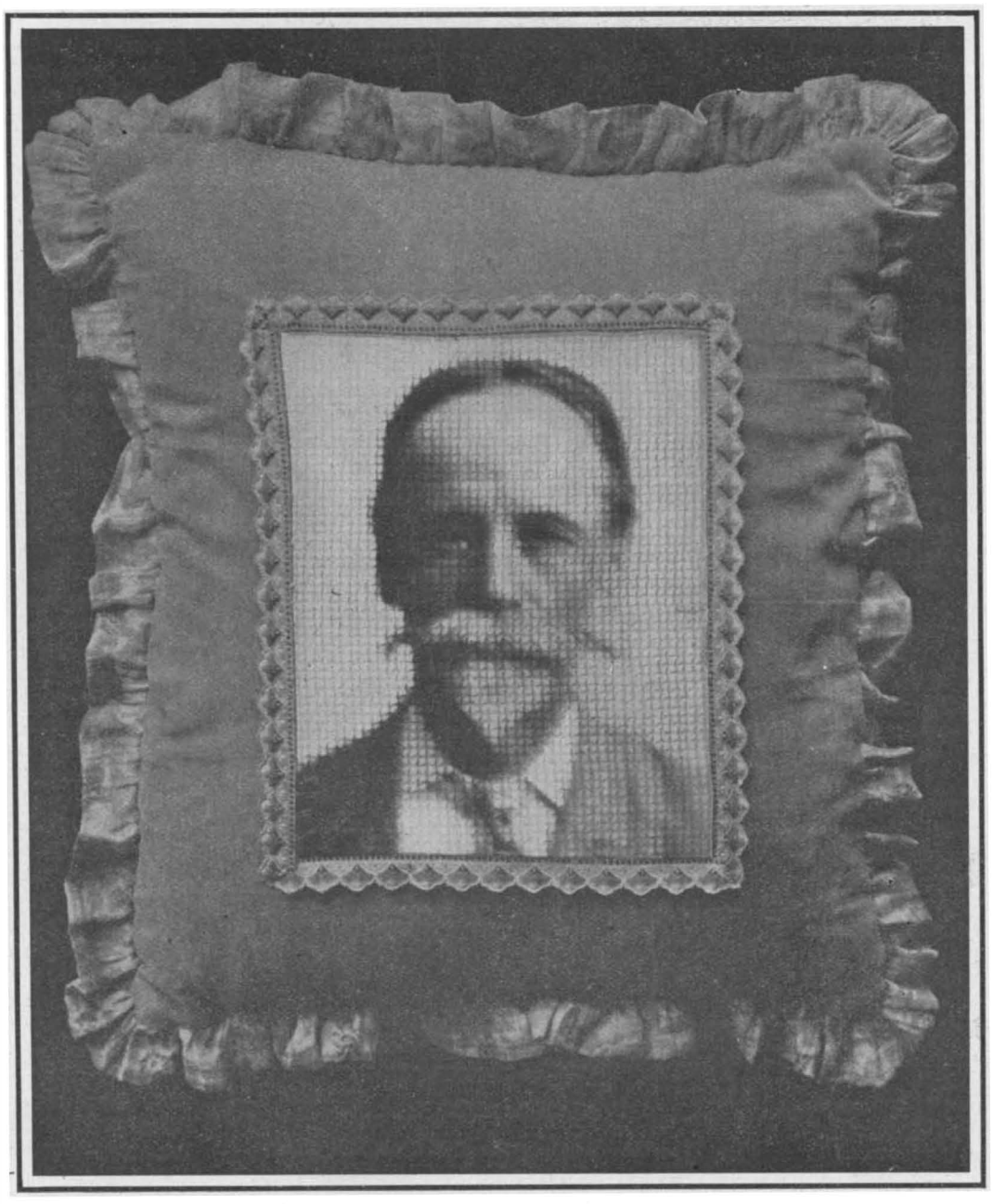
Tapestry effects in ordinary photographs can be even more easily produced than the bas-relief effects described in the January 12, 1907, issue of the SCIENTIFIC AMERICAN. A positive transparency and a piece of wire gauze are all the requisites. The best results are obtained when the following precautions are taken:

The printing frame is laid on the table, in the dark room, with the spring top upward. The top is taken off and, in the frame, are laid successively the positive transparency, with its film upward; a piece of wire gauze cut same size as positive; a piece of glass (an old negative the film of which has been rubbed off will do very well); the dry plate with its film downward; the spring top, which is then locked.

If the positive transparency is one of medium density, two matches, burnt at a distance of about two feet from the frame, in the direction of its diagonal and with variable incidences, will give an excellent tapestry negative. Owing to the position of the positive above the gauze and at some distance from the dry plate, the shades cast by the wire cut the figure into little squares, while the penumbra on each square closely imitate the relief of tapestry work.

If the piece of tapestry is to form part of an embroidered object, rug, arm chair, cushion, etc., a negative of the latter object must be made, to be used while printing. In the case of the cushion shown on the accompanying figure, a piece of black paper, the size and shape of the tapestry portrait, was cut out of a sheet large enough to cover the whole cushion negative, thus leaving a frame or border mark. Printing was done first with the cushion negative bearing the central mask of black paper, next with the tapestry negative and the border mask.

It is evident that after a negative of such an object as a cushion is made, it can be used afterward together with any number of portraits, groups, familiar landscapes, or monuments with tapestry effects.



PHOTOGRAPH WITH TAPESTRY EFFECTS.

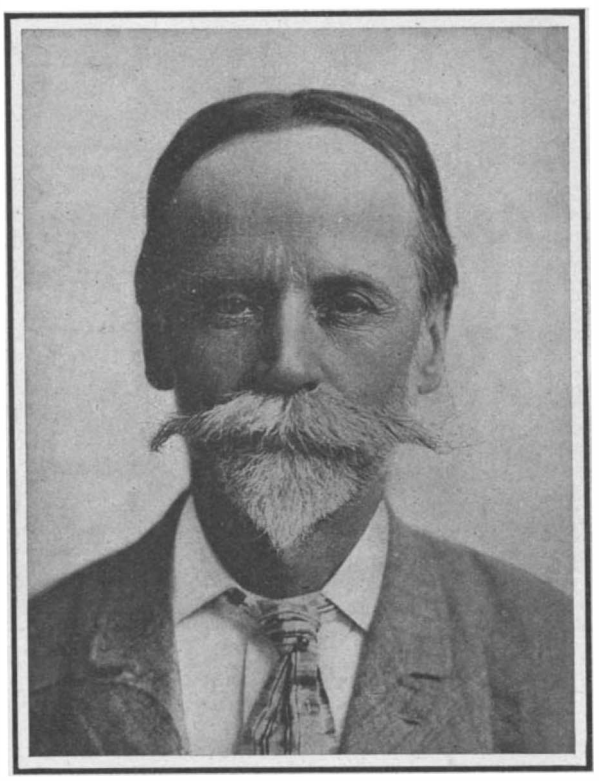
Destruction of Rats by Virus.

A short time ago the Department of Agriculture at Washington issued a report dealing with the rat, in which the remarkable fecundity of this animal and its extensive destructiveness were set forth. The troubles confronting American farmers are similarly experienced in Europe, and it is estimated that in Germany and Great Britain alone damage to the extent of $150,000,000 is wrought annually by this pest. Several attempts to check the animal have been made, but with poor success. Now, however, successful use is being made in Europe of a bacteriological preparation discovered by Prof. Neumann of Allborg, and known as "ratin." This preparation contains cultures of bacilli either in a liquid or solid form, which when eaten by the rats, set up a violent abdominal inflammation similar to malignant typhus, which kills the rodent within two or three days. The malady is highly contagious, the epidemic being so virulent that it spreads with lightning rapidity, and loses none of its deadliness in conveyance from one animal to the other. At the same time, the virus appears to be particularly appetizing to the animal, since it is greedily eaten.

Several severe tests of the virus have been carried out by various European governments, and in each instance complete success has been achieved. Owing to the success of these trials in Denmark, a bill has been introduced into the legislature to extend an appropriation of $6,750 per annum for three years toward the extermination of rats by this method, and some of the British colonies are now utilizing it upon an extensive scale.

Previous similar remedies, while fatal to rats, have proved equally dangerous to domesticated animals upon the farm. With regard to ratin, however, it has been found both by laboratory and actual trials that no other live stock, or human beings, can be affected by the virus, with the exception of sucking pigs and calves, which being unusually tender, are susceptible to the virus, a severe attack of inflammation of the bowels resulting from its consumption.

The bacilli are contained in a nutrient medium inclosed in air-tight tins. The preparation is either used in its crude form, being wrapped in small pieces



PHOTOGRAPH MADE IN THE USUAL WAY.

of paper and distributed in the haunts of the rats, or dissolved in milk in which pieces of bread and other dainties are dipped. Laid down over night, but little trace of the bait will be found in the morning; and should any rats be seen that have eaten the culture, they will be found either in a comatose state or quite dead, fatal results invariably occurring within forty-eight hours.

In carrying out the work of extermination, it is necessary that the first application should be effected upon extensive and thorough lines, the subsequent doses being decreased. In this way a severe epidemic is set up in the first instance, and any danger of the rodents becoming afflicted with a mild attack of the scourge in the first place, which might possibly render them immune in future, is averted. In the course of seven experiments that were carried out by the Chamber of Commerce for the Province of Saxony, in six instances the rats were practically exterminated, but in the seventh it exercised but little effect. A similar case of this peculiarity occurred in England, and this was attributed after prolonged investigation to the fact that these particular colonies had already been afflicted with the same, or a nearly-related disease, contracted under natural conditions, rendering those who survived practically immune from further infection.

The chief chemist at the ratin laboratories at Copenhagen, however, shortly afterward succeeded in discovering a stronger preparation for such instances, which proved completely successful, the rats which had withstood the inoculation from the previous preparation falling an easy prey to the latter organisms. It is equally destructive when applied to mice, though in this instance the cultures are supplied in a liquid form.

Owing to the method observed for the storing of the preparation in airtight tins, the bacillus will retain its virulence for some three months, but care must be observed in excluding sunlight from the medium when opened, as the microbe is quickly destroyed by such influence.

No odor offensive to human beings is emitted by the medium, and it is also stated that even should the diseased rats crawl to their holes or die beneath floors, etc., no offense is created by their dead bodies, a contention which has not yet been disproved, though it would appear that decomposition in such instances must set up unhealthy conditions. In many instances, however, it has been observed that when the epidemic breaks out in a rat colony, the members as far as they are able endeavor to leave the stricken spot; large numbers of the animals at farms where the virus has been applied being observed crawling away along the paths and fences until overtaken by death. When floorboards have been torn up in a rat-infested building, but few bodies have been found beneath, which tends to prove that the rats upon the outbreak of the contagion among their members at once make an effort to leave the place. In Great Britain several farms which swarmed with the pest have been completely cleared by the ratin bacteriologists of London, and the rats have not reappeared.

The Manufacture of Buttons.

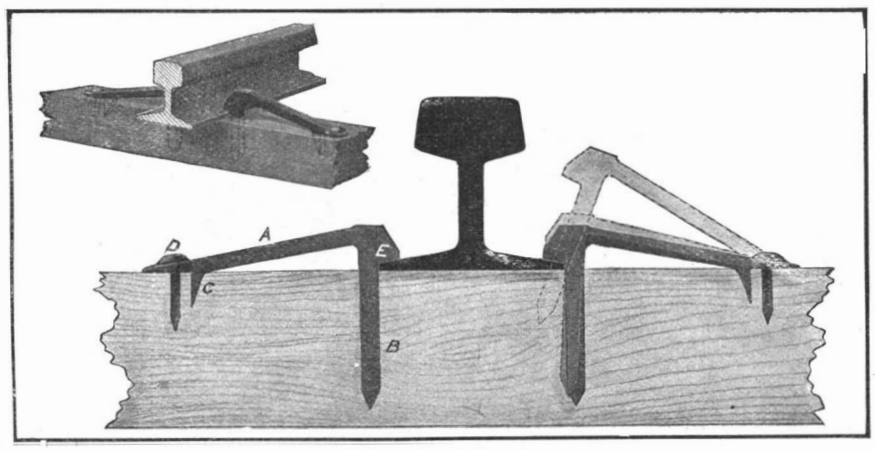
At the census of 1905, 275 establishments, with a capital of $7,783,900, were reported as engaged in the manufacture of buttons. These factories furnished employment for 11,335 persons, who earned an aggregate of $4,391,669, and the value of the products was $11,133,769; this including button blanks and other products. The leading variety of product was pearl buttons. The value of the 13,143,553 gross of such buttons was $4,870,274. As between fresh water and ocean pearl, the former greatly predominated, with 11,405,723 gross, valued at $3,359,167, or 69 per cent of the value of all the pearl buttons. Twenty-one States engaged in the manufacture of buttons, although only four had products valued at more than $1,000,000. New York was the leading State, with $3,849,317; New Jersey had $1,592,261; Iowa, $1,500,945; and Connecticut, $1,446,219. Almost one-half of the pearl buttons and about two-thirds of the vegetable ivory buttons were manufactured in New York. All the bone buttons were made in Pennsylvania. Button blanks were produced mainly in Iowa, the reports showing for this State 4,575,814 gross and a value of $594,946, or about two-thirds of the total.

Le Chatelier says that nitrogen to the extent of 0.02 to 0.045 per cent in steel is enough to cause the metal to break easily and to destroy ductility.

Patent Department

AN IMPROVED RAILWAY SPIKE.

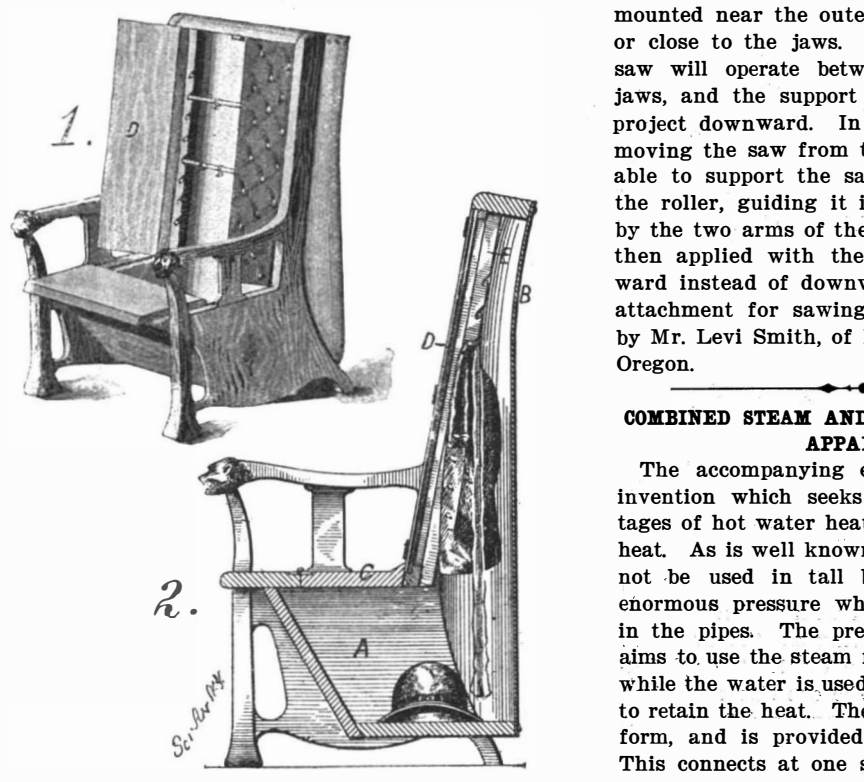
A recent invention provides an improved railway spike, so designed as to make it impossible to jar the spike loose, no matter whether the rails are closely mated or not. The main body of the spike is of the same dimensions as an ordinary spike, except that the head has a somewhat greater elevation. The spike is formed with a tang which projects laterally, and is secured to the tie to serve as a brace and hold the head against the base flange of the rail. A view of the spike and the method of its application is shown in the accompanying engraving. The tang is indicated at *A*, and is connected at one end with the spike proper *B*, while near the other end it is formed with a short spur *C*. Beyond the spur the tang terminates in an eye *D*, while the opposite end of the tang terminates in a head *E*. In applying the spike the main body *B* is first driven into the tie, so that the head *E* will overhang the flange of the rail. Then the spur *C* is driven into the tie, and a nail or spike is driven through the eye of the tang into the wood. With the spike thus firmly braced, it is next to impossible to pry it up by any jarring of the rail. That this is so is made apparent by the positions (shown by dotted lines in the engraving) which the spike would have to assume when pried out of the wood by a force applied to the head *E*. It will be clear from these dotted positions that the body *B* must tear its way through the tie, and not merely be withdrawn in the axial direction as in the ordinary spike. In other words, the spike becomes a lever, with its fulcrum at *C* and *D*. If the head *E* were lifted, the lower end of the body would have to tear an arcuate path through the wood. The inventor of this improved railway spike is Dr. Thomas W. Carey, Jr., of 809 Canal Street, New Orleans, La.



AN IMPROVED RAILWAY SPIKE.

COMBINED CHAIR AND CABINET.

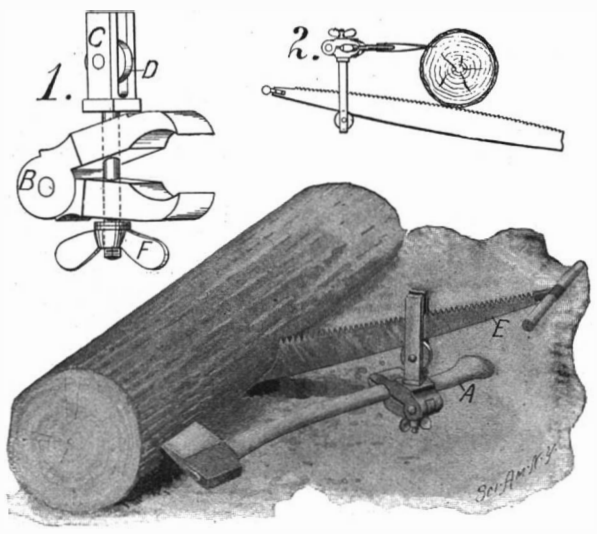
Pictured in the accompanying engraving is a chair which is formed with a cabinet in which various garments may be hung. The cabinet is so arranged as to provide ready access to the garments and it should form a convenient household device in which one may hang his overcoat and keep his hat. The details of the cabinet are clearly shown in the illustration. Beneath the seat of the chair is a box or chamber in which hats, gloves, and the like may be placed. At the rear the chamber extends to the top of the chair back, providing a space, *B*, in which coats and similar garments may be hung. Access to the lower chamber may be had by raising a hinged section, *C*, of the chair seat, while the chair back is provided with two doors, *D*, which may be opened to provide access to the articles hung in the chamber *B*. To the side walls of the chamber *B* two rails, *E*, are secured. These are formed with notches to receive the ends of transverse bars. A number of these bars may be used, setting them in different notches, and thus increasing the capacity of the cabinet. The transverse bars are provided with hooks or hangers which are free to slide along the bars to a convenient position. In use the device may serve as a hall chair and do away with the usual hat-rack and clothes tree. The inventor of this combined chair and cabinet is Mr. Charles J. Vlasak, of 3342 South Compton Avenue, St. Louis, Mo.



COMBINED CHAIR AND CABINET.

AX ATTACHMENT FOR SAWING LOGS.

Pictured in the accompanying engraving is a support or guide for a saw, which may readily be attached to a log or timber with ordinary tools to facilitate the sawing of the log. The details of this attachment are shown in Fig. 1. The attachment consists of a clamp adapted to be secured to the handle *A* of an ordinary ax. The clamp comprises two jaws *B*, through which a bolt is passed. The upper end of this bolt terminates in the support *C*. The support consists of two parallel arms, between which a roller *D* is mounted to rotate.

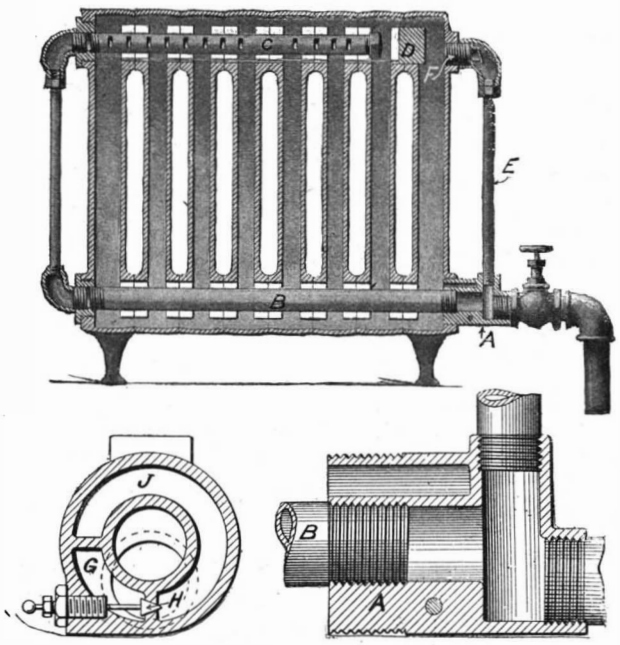


AX ATTACHMENT FOR SAWING LOGS.

The bolt which passes through the jaws of the clamp is fitted with a wing nut *F*, and by turning this nut the jaws may be pressed together on the handle of the ax. In use the ax is driven into the log, and the clamp is then made fast with the support *C*, standing vertically. The saw *E* is then guided between the arms of the support *C*, and the back of the saw rests on the roller *D*. With the saw thus supported and guided, it may be operated in the usual manner to saw through the log. The roller may be mounted near the outer end of the support *C*, or close to the jaws. In the former case the saw will operate between the roller and the jaws, and the support *C* must be mounted to project downward. In order to permit of removing the saw from the support, it is preferable to support the saw on the outer side of the roller, guiding it in the open slot formed by the two arms of the support. The clamp is then applied with the support projecting upward instead of downward. A patent on this attachment for sawing logs has been secured by Mr. Levi Smith, of Marshfield, Coos County, Oregon.

COMBINED STEAM AND HOT-WATER HEATING APPARATUS.

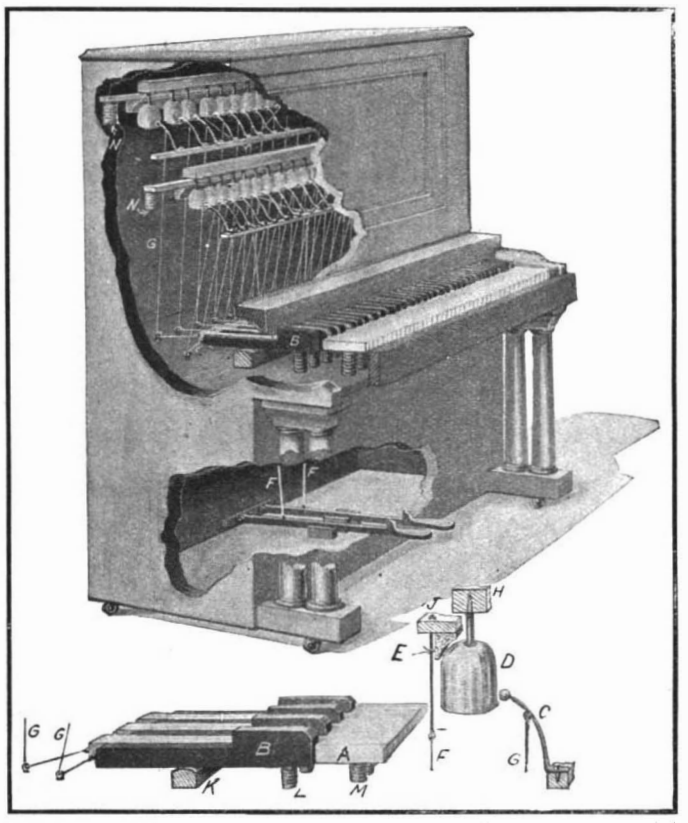
The accompanying engraving illustrates an invention which seeks to combine the advantages of hot water heating with those of steam heat. As is well known, hot-water systems cannot be used in tall buildings, owing to the enormous pressure which would be developed in the pipes. The present invention, however, aims to use the steam for distributing the heat, while the water is used in each radiator merely to retain the heat. The radiator is of the usual form, and is provided with a main fitting *A*. This connects at one side with the steam supply pipe, while at the opposite side a pipe *B* extends through the lower portion of the radiator. A vertical pipe at the rear end of the radiator connects the steam pipe *B* with a condensing pipe *C* in the upper part of the radiator. The condensing pipe is formed with openings to permit the water which is condensed from the steam to drip out into the radiator. The end of the pipe *C* is closed by a plug, and a plug *D* just beyond the pipe *C* partially closes the front section of the radiator from the other sections. The water of condensation is trapped in the radiator, and rises to a point near the top, where a valve *F* carries off the surplus through a pipe *E* to the fitting *A*. The interior of the radiator opens into a chamber *J*, as shown in the cross-sectional view of the fitting *A*, and this is separated from the chamber *G* by a valve *H*. In use the steam passing through the pipe *B* heats the water in the radiator, and the heat from the water is given off slowly and uniformly, as in the usual water heater. On opening the valve *H*, the water in the radiator passing through the chamber *J* is permitted to enter the chamber *G*, whence it is drained off through the supply pipe of the radiator. The inventors of this heating apparatus are Messrs. Alexander Zeck and Frederick Van Zeck, of Grafton, W. Va.



COMBINED STEAM AND HOT-WATER HEATING APPARATUS.

BELL PIANO.

The pleasing effects of bell music have hitherto largely been confined to clock and cathedral chimes, or to occasional use as a variation in orchestral productions. To be sure, we have sleigh-bell and hand-bell performances, but such music belongs in the class of freak exhibitions. Realizing that bell music would become very popular were it possible to play the bells with as much ease as stringed instruments are played, Mr. J. Havassy, of Copperhill, Tenn., has just invented an instrument which he calls the bell piano. As its name implies, it is a piano-like instrument in which bells are substituted for the strings. Details of the instrument are shown in the accompanying engraving. The keys *A* and *B* are connected with clappers *C*, arraged to strike the bells *D*. The latter are arranged in two banks, the upper bank being connected with



A PIANO-LIKE INSTRUMENT IN WHICH BELLS ARE SUBSTITUTED FOR THE USUAL STRINGS.

the black keys *D*, and the lower one to the white keys *A*. The clappers are spring arms provided with weighted heads, and their connection with the keys consists of wires *G*, fastened at one end to the clappers, and after passing through screw eyes, attached at their other ends to the keys. Just above each row of bells is a damper *E*, secured to a board *J*, which is arranged to slide vertically. Normally, the dampers are kept clear of the bells by the upward pressure of springs *N*. Whenever it is desired to damp the bells, a pair of pedals are depressed, and these by means of connecting wires *F* serve to draw down the boards *J*, and bring the dampers *E* into contact with the bells. The keys of the bell piano are mounted in the usual way to rock on a bar *K*, and they are normally pressed upward by springs *L* and *M*.

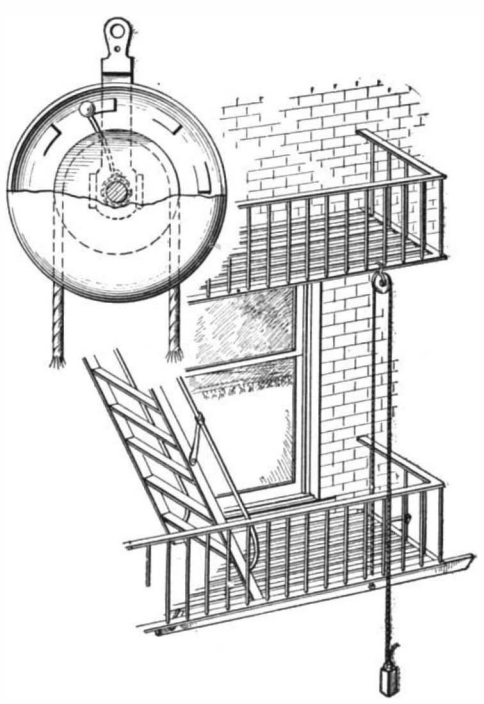
ODDITIES IN INVENTIONS.

A Unique Umbrella.—Owing to the fact that the handle-rod or stick of the ordinary umbrella is centrally disposed, a single person can occupy only one-

A UNIQUE UMBRELLA.

half of the space beneath the umbrella, with the result that his outer shoulder is usually exposed to the drip and rain. To remedy this defect, two inventors of Bridgewater, Va., have designed an umbrella which when raised will have the handle located to one side of the center, leaving the central portion of the sheltered space unobstructed. This umbrella when closed has substantially the appearance of the ordinary article. The umbrella stick is provided with the usual runner, but the stretchers instead of being connected to the runner as in the ordinary umbrella, are attached to a carrier which is connected with the runner by means of a pair of links. Hence, when the umbrella is closed, the ribs fold closely against the umbrella handle, but when the umbrella is raised they are tilted with respect to the handle, as illustrated in the engraving.

Alarm for Fire Escapes.—It is usual for fire escapes to terminate in a ladder, which is hinged to the lowest landing and which is normally raised clear of the ground, so as to prevent unauthorized persons from mounting the fire escape. A recent invention provides an alarm device which is attached to the hinged ladder



ALARM FOR FIRE ESCAPES

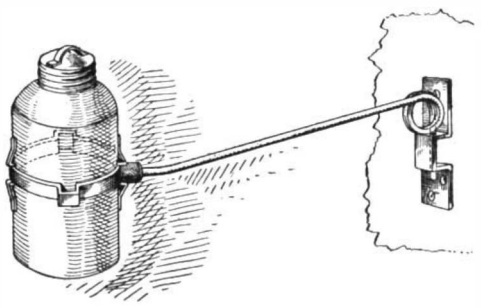
in such manner that should it be lowered, the alarm would be sounded. The device comprises a cable attached at one end to the hinged ladder, which passes over a pulley secured to the second landing of the fire escape, and terminates in a counter-weight. The pulley is mounted between a pair of bells, and the pulley shaft carries a clapper, so that as the pulley is rotated when lowering the ladder, the clapper will turn with it. In one of the bells a number of projections are provided, and these contacting with the clapper serve to vibrate the latter and sound the bells.

A Novel Toy.—A very simple toy has recently been invented, which should prove quite attractive to small children. It consists of a wheel mounted at the end of a bar or handle. Secured to this bar is a cylinder,

A NOVEL TOY.

provided with a whistle at its upper end. A plunger fits into the cylinder, and is connected by a rod to the wheel. The connection is eccentric, and hence, as the wheel is trundled along, the plunger moves in and out, alternately blowing and sucking air through the whistle. At each revolution of the wheel the whistle will be sounded twice.

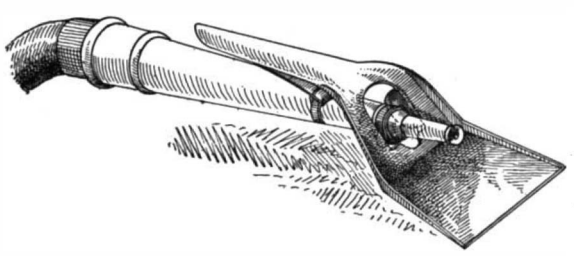
A Novel Churn.—Something decidedly novel in the way of a churn is provided by the invention which is pictured herewith. The churn comprises a cream receptacle which is mounted on a spring arm, and by merely rocking this arm the cream is churned. The cream receptacle consists of a can formed with a pair of double or spaced brackets at opposite sides. The rocking arm is formed of a spring rod or heavy wire provided with a frame at one end in which the can is received, and a coiled spring at the other end terminating in a vertical member which fits into a bracket.



A NOVEL CHURN.

The bracket may be secured to the wall at any desired location. The frame in which the can is received is provided with two offsets, so that when inserting the can the brackets will pass through these offsets, and then by giving the can a half turn the frame will be received between the spaced members of each bracket. To operate this churn the spring arm is pushed, producing an oscillation of the cream can and causing the cream in the can to dash up and down in a closed curve somewhat as traced by the figure 8. The descending cream in passing the ascending cream causes a friction on the butter corpuscles not experienced in the ordinary churn.

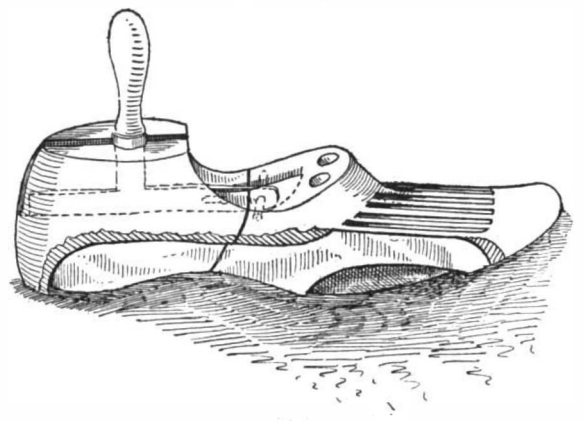
Sprayer for Hose Nozzles.—A simple attachment for hose nozzles has recently been invented, which will permit the operator to control the form of stream issuing from the nozzle. Thus the water may be permitted to flow either in a solid stream, or it may be sprayed to any extent desired. The device consists of a pan-shaped blade, which is hinged to the nozzle in



SPRAYER FOR HOSE NOZZLE.

such manner that it may be rocked toward or from the stream. The blade is formed with a handle which by means of a leaf spring bearing on the nozzle is normally pressed upward to keep the blade or deflector clear of the stream. When the operator so desires he may press on the handle, bringing the deflector into engagement with the stream, and thereby spraying the water.

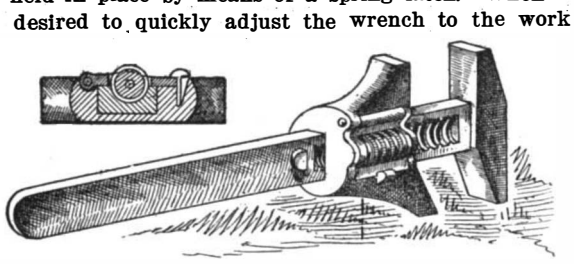
Ventilating Shoe Tree.—The advantages claimed for the ordinary shoe tree are that it will hold the shoe to the correct shape, and prevent the inner sole or sock lining from curling up at the edges. However, in order to make the shoe trees adjustable and provide necessary ventilation, it is the practice to make them of skeleton form, and hence the entire sole of the shoe is not equally held in shape. A recent invention aims to remedy this trouble. The shoe tree is in the form of a complete or solid last, and in order to provide for ventilation, a series of parallel slots are cut



VENTILATING SHOE TREE.

therein. At the bottom of the tree these slots extend almost the entire length of the sole, but at the top they open only in the forward part of the tree. The tree is formed of two sections, and a simple device is provided for expanding the tree lengthwise to permit of adjusting it to different sizes of shoes.

Improved Wrench.—The tool illustrated in the accompanying engraving embodies several improvements over the ordinary wrench. It is provided with oppositely-disposed jaws, the jaws on one side being set at an angle, so as to permit of using the tool in corners or places that would render the use of the ordinary wrench inconvenient or impracticable. The improved wrench is of the quick-acting type. The shank of the tool is provided with a fixed head, and is formed with a recess in which a half thread is cut. The movable jaws carry a feed screw adapted to fit this threaded recess. The feed screw is mounted in a hinged carriage or frame, and when engaging the threaded shank is held in place by means of a spring latch. When it is desired to quickly adjust the wrench to the work

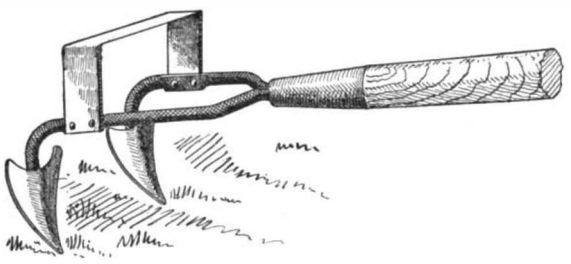


IMPROVED WRENCH.

the frame is swung upward, so that the screw will clear the frame, and the movable jaws may then be set to any position desired.

A Simple Garden Implement.—The man who raises his own vegetables should be interested in the simple implement shown in the accompanying drawing. It consists of a combined hoe or cultivator and weeder. The implement is attached to a wooden handle substantially like that of a hoe. It comprises a metal socket fitted with two diverging rods, which terminate in cultivator teeth of arrow-head outline. These are bent downward as shown. Secured to the two rods is a blade, which may be used for weeding. The operator thus has two tools at his command, either one of which may be brought into use by merely turning the handle of the implement.

In operating a coal-cutting machine by electricity the most economical means for transmitting power from the feed wire in the entry to the machine is, says an engineering contemporary, a cable which is carried



A SIMPLE GARDEN IMPLEMENT.

about the mine with the machine. This cable is usually 250 feet long, sometimes longer, and is wound upon a convenient reel. The cable should be of the twin type, two wires being laid side by side, thoroughly insulated from one another and securely bound together. At the ends of each cable two hooks should be attached for making contact with the wire in the entry.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

HOSE-SUPPORTER.—MARY T. LEWIS, near Marseilles, Ill. In this case the intention is to provide an improved hose supporter arranged to properly support the hose and to avoid all undue strain on the hose, thus preventing tearing thereof, especially at the connection of the supporter with the upper end of the hose.

Electrical Devices.

TROLLEY-POLE.—H. BOUCHARD, Austin, Tex. It will be found in this improvement that the pole is extensible and contractible, and that the means for retaining the pole in alinement with the bracket and in fixed relation with respect thereto, is operated by the extension and contraction of the pole, the extending of the pole acting to release the retaining means.

INSULATOR.—G. W. CARTER, Canyonville, Ore. By the inventor's construction he avoids any displacement of the line wire holding the same permanently in connection with the insulator body and also makes the insulator bodies in contrasting colors so they will indicate by the color as well as by distinguishing marks the character of the current on the wire held to the body.

HEATING DEVICE.—W. E. H. MORSE, Algona, Iowa. The invention relates to a device for applying heat to a portion of one's body, and is intended to be used in the practice of therapeutics. The object is to produce a device which will operate to concentrate the heat upon the affected part. It is intended that this electric device is much easier to prepare for operation than a hot water bottle or similar device.

Of General Interest.

FOLDING PAPER BOX.—J. M. YARNALL, New York, N. Y. The purpose of this invention is to provide a paper box that when not in use will fold flat, or which will accommodate and perfectly adapt itself to cylindrical objects or objects that are practically of that form, and further to so construct the box that it will be very simple and exceedingly economic.

TESTING APPARATUS.—J. M. VON HASSEL, Lima, Peru. This apparatus is more especially designed for testing the resistance or strength of air dried bricks and similar materials used in building houses, with a view to determine whether the walls of such houses are safe or of sufficient strength to bear another story or to allow the use of heavy machinery in the building, etc.

DRIER.—H. W. RAYNER, Eagle Lake, Tex. This improvement is especially designed for drying bagasse, or crushed cane, milled or diffused sugar cane from a sugar mill. For this purpose Mr. Rayner utilizes waste heat; that is, the flue gases or the resultant of heat after it has been utilized as heat of direct combustion to raise steam under a boiler, in heating the drier for driving off the moisture.

ORE-CONCENTRATOR.—R. H. MANLEY, San Francisco, Cal. Broadly stated the invention comprises a revoluble and vibratory bowl in which the tailings containing gold or other metal are placed. As the tailings are lighter than the gold, they are worked to the surface by the vibratory motion and thence carried over the top edge of the bowl under the action of the centrifugal force developed.

BOAT-DETACHER.—E. H. LINDMAN, San Pedro, Cal. Means are provided by this inventor whereby the boat may be automatically released by the action of the water in case of a vessel sinking; or by which the boat may be quickly released by hand whenever desired. The devices can be used with boats now supplied to vessels and require no change in the construction of such equipment of vessels.

PROCESS FOR PRODUCING ELECTRIC RESISTANCE BODIES.—J. KRANNICHFELDT, Cologne, Prussia, Germany. For the purpose of this invention, the conducting particles of the mixture, before it binds or before it finally solidifies, are directed or adjusted, similar to particles of a coherer, by the electric current or by electric impulses or undulations. By doing this in one or more operations the electric resistance of the body is reduced, and this condition is fixed or becomes permanent by the subsequent solidification or binding thereof.

PICTURE-FRAME.—ELEANOR G. HEWITT, Ringwood Manor, N. J. This frame is more especially designed for holding and displaying interchangeable pictures, drawings and the like, and arranged to protect the picture against dust, and to permit convenient and quick opening of the frame for removal of a picture and the substitution of another.

DRY ORE-CONCENTRATOR.—J. HUBERT, Reno, Nev. The object of the improvement is to provide a machine to separate the gold from dry gravel or tailings by means of a table having thereon riffles adapted to catch the heavier and finer particles, or values, as the gravel travels over the table, which is swung up and down vertically and oscillated laterally, as well as given a shaking or jarring motion by further means.

TIGHTENER.—J. M. EVANS, Chanute, Kan. An object of the invention is to provide a device by means of which single wires as well as strips of woven wire fabric of different widths can be drawn taut to permit the same to be properly mounted upon fence posts and the like. The tightener has clamping means for securely holding wide strips of woven wire fence material and serving to draw the same taut in constructing fences and the like.

Hardware.

NUT-LOCK.—C. B. STILLWELL, Jacksonville, Fla. This invention has reference to nut locks which are used for preventing the accidental displacement of nuts from their bolts. It is capable of use in many connections, but is especially adapted for use at rail joints for preventing the disconnection of the nuts on the bolts which fasten the fish plates in position.

Household Utilities.

KITCHEN DEVICE.—E. A. HUDSON, Oquawka, Ill. The object in this instance among others is to provide a device for trimming the edges of pies, punching ventilation holes in the top pastry thereof and also crimping and sealing the edge of the pie simultaneously, when the device is placed down in cutting position and slight pressure is exerted.

Machines and Mechanical Devices.

DITCHING-MACHINE. — L. THORTVEDT, Glyndon, Minn. One of the purposes of the invention is to provide a very light form of machine adapted to be drawn or driven by a steam or other motor, and to provide the driving shaft with a hoisting capstan, and one or more drag capstans that assist in the filling of the shovels or scrapers to be hoisted, which drag capstans are independent of the hoisting capstan.

BALANCED VALVE.—L. J. RIGSBY, Manning, Tex. In the present patent the invention has reference to balanced valves for general use and more particularly to a type of valve suitable for use in sawmill mechanism for the purpose of manipulating the supply of steam or similar elastic medium to the part commonly designated as the shot gun.

BURGLAR-ALARM BOX.—A. LO FARO, New York, N. Y. The invention has for an object primarily to automatically and continuously sound an alarm should the box be picked up and attempted to be carried away by an unauthorized party. The box is particularly desirable as a safety deposit means for valuables at theaters and other public places, for which the invention is more especially intended.

CANE CUTTER AND CRUSHER.—C. W. HARRIS, Hawkinsville, Ga. In this case the invention pertains to cutters and crushers for sugar cane and the like, and the more particular object being to produce a simple machine of this type, operated by hand, and exceedingly simple in its construction and operation.

ENGINE-STARTER.—H. P. FRANCIS, Oroville, Cal. The apparatus is for use in starting engines, particularly internal combustion engines, and belongs to that class in which a spring or other means of storing energy is employed, the spring being wound by the normal operation of the engine and reversed to turn the engine when the same is to be started. The action of the mechanism is as nearly automatic as possible.

Prime Movers and Their Accessories.

ROTARY ENGINE.—R. H. WRIGHT and M. S. GILL, Mexico, Missouri. The engine will be found especially useful in compounding, in doing which the primary and secondary engines, etc., may be constructed alike, except varying as to size, as is usual in compound engines, and those of the series may be suitably geared, as will be understood by those skilled in the art. This special adaptation results largely from the relative arrangement and number of abutments with respect to piston blades, whereby steam exhausted from one engine to the succeeding is taken from between closed abutments.

COMPRESSOR FOR INTERNAL-COMBUSTION ENGINES.—H. W. ADAMS, Fargo, N. D. In the present patent the invention relates to a compressor, and more particularly to means for controlling the inlet valve according to the pressure created in the delivery pipe from the compressor. The construction is particularly applicable to two-cycle internal combustion engines.

Railways and Their Accessories.

CAR-STAKE.—T. ELLIS, Tacoma, Wash. The object of the invention is to produce a car stake which will constitute a good substitute for the wooden stakes now employed, and which can be readily brought into operative position when the logs are to be loaded in the car.

RAILROAD CURVE TESTER AND GAGE.—J. T. TAYLOR, South Boston, Va. The invention may be used either in laying a new track or in correcting an old one, by track hands having no special knowledge of surveying, the device enabling the ordinary workman to correctly lay a curve of any desired radius or correct irregularities of an old curve. It is especially useful on short curves of street railroads.

RAILWAY SAFETY APPARATUS.—R. H. HUNT, Chelsea, N. Y. This apparatus is designed for use in connection with track devices for controlling a locomotive, and has for its object to provide means adapted to automatically shut off the supply of steam to an engine cylinder and apply the brakes when a track device or obstruction is met in the path of the engine adjacent to the rail.

CAR-STAKE.—J. FELKEY, Bemidji, Minn. The stake is for use in lateral support of timber or logs, piled as a load upon a platform-car. The object of the invention is to provide novel details of construction for a car-stake, which will reliably hold it erected and permit the ready release of the stakes so that it may be rocked into a plane below the bottom of the car for a convenient lateral removal of the load therefrom.

Pertaining to Recreation.

PUZZLE.—R. D. MARTIN, Habana, Cuba. In the present patent the invention has reference to puzzles, and the object is the provision of a new and improved puzzle, arranged to afford a considerable amount of amusement and to require skill on the part of the player in successfully solving the puzzle.

SWITCH FOR PLEASURE-RAILWAYS.—S. E. JACKMAN, New York, N. Y. The object here is to provide a switch, arranged to permit of conveniently and quickly running the cars from a storage floor to the track of the railway, and from the track back to the storage floor, as required by the demands of the traffic, and without seriously interrupting the running of the railway. The invention refers to inclined or switch-back pleasure railways.

PORTABLE COASTING DEVICE.—J. C. BOYLE, Calgary, Alberta, Canada. The construction of this device enables it to be quickly placed in position for use on a lawn, porch, or indoors, and afford great amusement for children. It will not injure persons, clothing or furniture; it may be used by a number at a time and folded into a compact package when not in use.

Pertaining to Vehicles.

MOTOR-VEHICLE.—J. RITCHIE, New York, N. Y. The aim in this invention is to provide a device in which the driving shaft carries a hollow shaft free to rotate thereupon and actuated by a coiled spring, and a clutch for operatively connecting the driving shaft and the hollow shaft, the latter being adapted to be operated to wind the spring when it has run down.

TRUNK-FASTENER.—G. J. LOOS, New York, N. Y. The invention has in view the provision of a device which may be easily and quickly adjusted, and which will securely strap or clamp a trunk to a vehicle or in any other relation in a manner that the trunk will be rigidly held and cannot be unauthorizedly cut loose and stolen.

EXPLOSIVE-MOTOR.—C. R. GERGLER, New York, N. Y. The invention relates particularly to air-cooled, four cycle explosive motors intended to be used for the propulsion of motor cycles of that type having admission and exhaust valves at the top of the cylinder, and wherein the latter is further provided with one or more exhaust ports, so situated that the piston on reaching the lowest point of stroke allows the interior of the cylinder to come in communication with the atmosphere. The purpose is to provide the cylinder with means whereby to open or close said ports at will.

TRACTION-VEHICLE.—R. E. ZAGER, Branscomb, Cal. An object of this invention is to provide a vehicle in which the vehicle body is mounted on a plurality of swivel trucks which may be propelled singly or collectively by a single engine. Another object is to provide a novel steering gear whereby all the parts may be simultaneously swiveled without swiveling the trucks, and whereby the trucks may be swiveled as well, if desired.

Designs.

DESIGN FOR A JUG.—O. KOPEL, New York, N. Y. In this ornamental design for a jug the body of the article has the form of a "Teddy Bear." The sitting position of the animal with extended hind legs forms the base of the jug, the handle being situated in its back.

DESIGN FOR A HACKSAW-FRAME.—L. A. KIMBALL, New York, N. Y. This patent for a design includes a frame proper of an ornamental form or configuration and a handle, the whole presenting a very neat, gracefully curved, yet substantially embodied implement.

DESIGN FOR A CAMPAIGN-BUTTON.—C. F. PEARSON, Portland, Ore. The ornamental design shows a circular button with a distinct and attractive monogram T. C. B. completely filling the area of the circle and each letter represented by a different color or texture against the background of the button.

DESIGN FOR A PIN OR BUTTON HEAD.—D. P. BARRY, New York, N. Y. This new and ornamental design for a pin or button head has a very blunted oval form, the outlines of the exterior and those of the inner surface being purposely slightly irregular. A letter m occupies the mottled surface of the inner oval.

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(10687) W. F. L. M. asks: Will you settle a dispute that is going the rounds in this community? A claims that black cloth is the warmest wear at all times of the year. B claims that white cloth is the warmest. Which is right? A. So far as color has any effect upon the warmth of a garment, black is the warmest and white the coolest. Black absorbs heat and white reflects heat to the highest degree. Hence white is worn in summer and black in winter. A garment however derives its warmth more from its texture than from its materials or color. The larger amount of air held in the meshes of the cloth makes a garment warmer than one which holds less air.

(10688) E. E. says: The question has arisen whether the Atlantic cable rests upon the bottom of the ocean or not. A claims it does, while B claims that it does not, the density of the water supporting it in many places. Kindly advise which is correct. A. The Atlantic cable rests upon the bottom of the ocean all the way, or else it would break by reason of the strain upon it, from its own weight. Anything which sinks in water at sea goes to the bottom. The density of the water at great depths is but slightly greater than at the surface, since water is practically incompressible. Everything, excepting mercury and glycerine, both liquids, is more compressible than water. The densest steel is more compressible than water, and will grow heavier by compression more rapidly than water will. There is no foundation for the popular notion of things floating at a certain depth under water because the water has grown dense enough to support them. See answer to Query 10485, Vol. 96, No. 13, which we send for ten cents. This gives a full discussion of the subject, with reference to authorities.

(10689) A. W. S. says: Please tell me the name of the best cheap non-conductor of heat. A. A vacuum is the best non-conductor of heat. The best material for this purpose is asbestos.

(10690) C. W. S. asks: Will you give me an explanation of the action of a mute on a violin or cello? A. The effect of the mute on a violin string is to reduce the amplitude of the vibration of the string. The periodicity of the vibration being unchanged, the air vibrations causing the sound are at the same rate and the note is unchanged, but the reduced amplitude of the vibration decreases the volume of sound.

(10691) J. W. B. asks: Is it possible to convey a current of electricity from a battery, stored in a locomotive, to the rail, through the axle and wheel? Does not the oil bearing interfere with a perfect connection? A. We presume it is possible to convey a current of electricity from the locomotive to the rail through the axles and wheels, though we never tried the experiment. We think so, because the current from the overhead trolleys goes through the motor and the axles to the rail and returns to the power house in that way only.

(10692) H. J. N. wishes to know how to remove indelible ink marking from clothing. A. Indelible inks are of such variable character that it is quite impossible to reply. Many of these inks have nitrate of silver as a basis; in this case, a solution of hyposulphite of soda might help. Some other inks might possibly be bleached out with javelle water and weak muriatic acid; this can be used only on white goods, as most dyes would be destroyed. Possibly also a solution of sulphurous acid might be of service.

(10693) R. L. N. asks: Can you tell me how to construct a lamp or light that will burn under water (outside of an electric device). Any hints how to proceed will be appreciated. A. Any lamp will burn under water if protected from the water and supplied with air. We do not know any other way to produce a light under water. An electric light does not need air, a fact which renders it easier to have light under water by electricity, but this is out of the question with you. The metal potassium will burn under water. No means has been devised for utilizing the fact for illumination. Its cost is too great for such a use.

(10694) P. N. F. asks: 1. What would be the effect on a corrugated iron roof if lightning should strike it? Is it dangerous to the inmates of a house to use such material for a roof? A. If your corrugated iron roof is connected with water or moist earth at several points by heavy telegraph wire or small iron rods, it will serve very well as a lightning rod to protect the premises from being struck. If not connected to the earth, we think it is a source of peril. 2. Of what cheap material can we make a belt about 8 feet in length for light service, width 1½ inches? A. Belts are either made of leather or webbing. They must be inelastic, so as not to stretch in service. We do not know of any cheap substitute for regular belting.

(10695) A. A. W. says: I have a brass coil boiler, in which there is a great deal of sediment and scale and which is steaming poorly; please advise me what preparation I can clean it out thoroughly with. A. You can clear the sediment and incrustation in your boiler by injecting a strong solution of caustic soda, say 10 per cent of the contents of the boiler, using it for the day; then blow out while steam is up, and repeat for a few days.

(10696) N. P. L. asks: 1. About an ink which can be used with a drawing pen upon zinc and which when dry or burned in will be acid-proof. A. Ink for Zinc Labels: Take 1 drachm verdigris, 1 drachm sal-ammoniac powder and ½ drachm lamp black, and mix them with 10 drachms water. This will form an indelible ink for writing on zinc. 2. A means for an amateur to impart a polish (high) to chestnut boards. A. Fill the wood with any good filler, let it dry, then apply a good varnish, two or three successive coats. Rub it down with powdered pumice stone, then with rotten stone, and finally finish with whiting, all in water. Apply with a felt or flannel rubber.

(10697) B. G. I. asks: What is meant by a twenty per cent grade? A. A twenty per cent grade rises or falls 20 feet for every 100 feet measured horizontally and not on the slope. In other words, the grade is measured by the tangent of the angle of inclination and not by its sine, so that a 100 per cent grade corresponds to an inclination of 45 deg. and not to an inclination of 90 deg. A slope, as of an embankment, is usually designated as of so many to 1; for instance, the usual slope of earthwork is 1½ to 1, meaning 1½ horizontal to 1 vertical. But, conversely, the grade of a road is sometimes given as of 1 in so many, meaning a rise or fall of 1 foot vertically for so many feet measured horizontally; for instance, a grade of 1 in 20 would be a 5 per cent grade and of 1 in 5 would be a 20 per cent grade. You will find such matters explained in Trautwine's "Civil Engineer's Pocket Book." Price, $5.

(10698) T. M. G. asks: In still air will two spheres of the same size, one of aluminium and one of lead, fall from a given height in the same time? A. Since the velocity of a freely falling body is dependent only upon the mass of the earth, it follows that all bodies will fall in a vacuum with the same velocity, viz., 32.16 feet at the end of the first second of fall; and since the air will resist two spheres of the same size equally, because they displace the same weight of air, it follows that the two spheres of the same size will fall with the same velocity under the action of gravity in the air, and therefore will fall through a given height in the same time.

(10699) R. H. J. writes: I desire to purchase books which would thoroughly inform me upon the following case: A building is lighted with 23 incandescent lamps arranged in parallel. The current is supplied through a transformer which reduces the voltage from 2200 to 110. A man takes hold of the socket of one of the lamps and is killed. I want to be able to inform myself on the following questions: First, the precautions necessary in handling high-tension currents and where the danger points are. 2. The liability of transformers to leak, break down, etc., thus delivering the full voltage to the wire leading from it, etc. 3. What is the cause of death? Is it wattage, voltage, amperage, and what is the usual amount necessary to kill a person? Would the current coming from a transformer cutting it down to 110 volts and necessary to supply 24 incandescent lamps be sufficient? Would that supplied to one of these lamps be sufficient? A. Thompson's "Elementary Lessons in Electricity," price $1.40 by mail, contains as much as is given in any one book upon the topics concerning which you inquire. Rubber gloves and tools with insulated handles are necessary for handling wires carrying current above 110 volts. This pressure may have inflicted severe injury or even death in extreme cases, but we do not recollect any instance of death from it. In the case cited it would seem as if there must have been a connection with the primary of the transformer. Death is caused either by the shock of the current or by the disintegration of the vital tissues from its continued action on them. The amperes are the agent of electrolysis; the volts determine the amount of amperes which can flow through a circuit in proportion to its resistance, as expressed in ohms. The resistance of the human body is a variable quantity, from a few hundred to perhaps five thousand ohms. What current a man can get is not a question of the supply of one lamp or any number of lamps. It is a matter of the voltage of the current and the resistance of the body.

(10700) S. N. F. asks: How can I remove nitric acid stains from a blue cloth coat and bring it back to its former color? The acid having been dropped on the cloth and pressed with a smoothing iron, causing the part of the cloth where the acid dropped and was pressed to turn yellow. A. The stain caused by nitric acid on blue cloth can be removed by the *immediate* use of ammonia, in case the acid was weak. Strong acid will usually give a permanent stain. With an old stain from nitric acid nothing can be done.

(10701) C. M. B. says: If I were to take a cannon 3 inches in diameter and 1 inch bore and fit a screw cap firmly on the mouth of it, and then explode a piece of guncotton within, while the cap is screwed on: 1. Would the cannon burst? A. Plugging up a cannon charged with guncotton is a dangerous experiment. The charge would burst the cannon or blow out at the vent. 2. After cooling it would there be any explosion upon unscrewing the cap? A. There will be no danger in opening the cannon after explosion if it did not open itself 3. Do you think the heat generated within the cannon would be sufficient to melt an iron or brass screw ¼ inch or ⅛ inch in diameter? A. The heat of the explosion is too quick to melt the screw.

(10702) B. A. E. writes: I would be pleased to know by what chemicals or solutions blue prints may be changed from their original color (blue) to colors heretofore discovered? A. Blue Prints, to Change to Brown: Borax, 2½ ounces; hot water, 38 ounces. When cool add sulphuric acid in small quantities until blue litmus paper turns slightly red, then add a few drops of ammonia until the alkaline reaction appears and red litmus paper turns blue. Then add to the solution 154 grains of red crude gum catechu. Allow it to dissolve with occasional stirring. The solution will keep indefinitely. After the print has been washed out in the usual way, immerse it in the above bath a minute or so longer than it appears when the desired tone is reached. An olive brown or a blackish brown is the result. To Make Blue Prints Green: Make four solutions as follows: Solution A. Water 8 ounces and a crystal of nitrate of silver as big as a pea. Solution B. Hydrochloric acid 1 ounce and water 8 ounces. Solution C. Pour a solution of iodide of potassium (iodide of potassium 1 ounce and water 8 ounces) into a saturated solution of bichloride of mercury until the red precipitate is just dissolved, and then add four times as much water as the resulting solution. Solution D. Water 16 ounces and iodide of potassium 1 drachm. Then take the blue print and bleach it with solution A, when the image will become pale slate color or sometimes a pale yellow. Then wash thoroughly and immerse the print in solution B, when the image will again become blue. Then, without washing, immerse the print in solution C, when the image will become green but the "whites" will be of a yellow tint. Then put the print in solution B again, without washing. Then wash and pour solution D over the print to purify the whites and to give the green image a bluer tint; but do not leave print in this solution too long, as it has a tendency to make the print blue again.

(10703) C. C. asks: Please answer the following questions: I do not know whether the name is correct, but I have heard that selenium, a metal, changes its resistance to electricity when light strikes it. Kindly inform me about the price, the resistance it offers per square meter of surface, and whether the supposition that it increases its resistance when light strikes it is correct; also how sensitive it is. A. Selenium is not a metal, but an elementary substance which in its ordinary condition is a brittle solid of a glassy luster and fracture and a brown color. It melts at about 430 deg. Fahr., vaporizes at about 1,300 deg., and burns with a blue flame, giving out an odor resembling that of putrid horseradish. Ordinary selenium is a very poor conductor, having an electrical resistance 37,500,000,000 times that of copper. When annealed for several hours at a temperature just below its melting point, with subsequent slow cooling, it forms a crystalline substance with a lower resistance. It is now sensitive to light. Its resistance is reduced, not increased, in proportion to the square root of the illumination; and also the effect is greater with a high electromotive force than with a low one. Narrow strips of annealed selenium are formed between the edges of broad plates of metal, so that the cross section is considerable, and thus the resistance is reduced while the area exposed to light is considerable. This is a "selenium cell." When the light strikes it, its resistance may be reduced as much as one-half. A cell whose resistance in the dark was 300 ohms dropped to 150 ohms in the light. Such a cell is not a generator of electricity, but a measuring instrument for determining the intensity of light.

(10704) V. A. L. asks: 1. Will you kindly explain the action of the inductor alternator, of the type not having a large cylinder at one end? A. The toothed projections upon the moving portion are called the inductors. The surrounding frame has projections of the same shape and size, which constitute the cores of the armature coils. When these two sets of projections are opposite each other, the magnetic reluctance is at the minimum and the magnetic flux through the armature coils is at the maximum. Similarly, when the inductors are in the intermediate position, the flux is at a minimum. Thus the current is produced without moving wire, or collecting devices, with their attendant risk of chafing and loss of energy by friction. See Sheldon's "Alternating Current Machines," price $2.50, by mail. 2. Why is it that, although the current from an X-ray induction coil is alternating, the discharge passes through the tube in only one direction? A. The secondary current in an induction coil is not alternating when the discharge points are drawn out so far that the spark passes only when the primary circuit is broken. The current then is a succession of impulses all in the same direction, the current produced by the making of primary current is suppressed, not being able to leap the gap. The X-ray tubes used with direct current in the primary coil are all energized in this manner. Their current is unidirectional and discontinuous, and not alternating. 3. In the 110-volt alternating-current system of incandescent lighting, why is it that, though the circuit is always complete through the primaries of the transformers, more power is required when more lamps are put in use on the secondary circuit? A. In any system of incandescent lighting by multiple arc, or parallel arrangement, when one lamp is on, the resistance is such that only the current required for that lamp can flow; when two lamps are turned on, the resistance is half of what it was before, and twice as much current flows. More power is therefore required of the generator. If no lamps were lighted, the generator would not be called upon for any current, and it would run free, offering no resistance to motion except the friction of its armature shaft. This is true of all dynamos, alternating or direct.

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Course in Isaac Pitman Shorthand. An Exposition of the Author's System of Phonography, designed for use in Business Colleges, High Schools, and for Self-instruction. New York: Isaac Pitman & Sons. 16mo.; cloth; 241 pages. Price, $1.50.

A system of phonography founded upon the association of characteristics of the sound represented with the nature of the symbol.

Morphology and Anthropology. A Hand Book for Students. By W. L. H. Duckworth. New York: G. P. Putnam's Sons. 8vo.; cloth; 568 pages. Price, $4.50.

Anthropology is a subject of the widest scope. Within its borders are subjects of apparently no similarity or interdependence. When, however, we turn to a morphology, we have removed the limits to a sufficient extent to allow of the possibility of covering the field in one volume of reasonable size.

This number of the Cambridge Biological Series, of which the general editor is the eminent Arthur E. Shipley, M.A., F.R.S., contains the comparative studies of the higher mammals and man that have done so much to place our knowledge of evolution on its present plane.

A Treatise on Crystallography. By W. J. Lewis, M. A. Cambridge: The University Press, 1899. New York: G. P. Putnam's Sons. Cloth, 5½ by 9 inches; 604 pages; 553 figures. Price, $4.50.

Although this is an old book, it has never before been mentioned in the American press. It sets forth the views held as to the classification of crystals, and the principles of symmetry on which the classification is based.

Economics of Railway Operation. By M. L. Byers. New York: Engineering News Publishing Company, 1908. 8vo.; cloth; 672 pages, illustrated. Price, $5.

During the early days of railroads, the entire problem of their possible usefulness, being new, was given consideration from a broad standpoint, and by men of great ability, so that the writings of Stephenson, De Pambour, Lardner, Ellett, Fink, and others contain primary economic truths which are of great interest and value at the present day. After the first period of analysis, came, in the history of railway operating methods, a period of management by application of direct personal leadership in the solution of problems as they arose. With the growth of the railroads, however, and with the increase in the number of details, came a difference in the methods of handling railway affairs. Departments were created, divided, and again and again subdivided. Officials found that more and more elaborate reports to guide them were necessary; the day of the specialist arrived. This resulted in the collection everywhere of great masses of data, more or less available, in regard to current apparatus. The author of this work has brought into view the general outline of the mechanism of railway operation as it is carried on to-day. He develops the principles which have governed in producing the form this mechanism has assumed, and those which underlie its economic use. While the amount of detail in connection with this enormous question is very great, the attempt has been made to afford sufficient clews to the various ramifications of the subject to make it possible for the student having access to such details to study matters with reference to their relation to the subject as a whole.

The World Almanac and Encyclopedia. 1908. Twenty-fifth Anniversary Number. New York: The Press Publishing Company, New York World. 1,000 pages; paper bound. Price, 25 cents; by mail, 35 cents.

The World Almanac for 1908 has just reached us. It contains, as usual, a fund of necessary information on an astonishing number of topics. The résumé of scientific progress during the past year is very complete, and is written with a clear understanding of the subject.

Final Natural History Essays. By Graham Renshaw. London: Sherratt & Hughes. 8vo.; illustrated; 225 pages. Price, $2.40.

There is nothing startling in the photographs illustrating Mr. Renshaw's work, either in clearness or in the manner in which they were taken. They do, however, explain and make clear a very interesting text, written with no mean degree of skill by one absolutely familiar with animals, from both the historical and the zoological standpoint. Mr. Renshaw has a particularly graphic pen, and his picturings of the haunts of the beasts he describes are surpassed in vividness by the productions of few authors.

The Cotton Mills of South Carolina. 1907. Letters Written to the News and Courier by August Kohn. Charleston, S. C.: The Daggett Printing Company. 8vo.; paper; 228 pages.

A description of the conditions existing among the cotton mills and cotton-mill operators of South Carolina.

Compositæ of Southern California. By Harvey Monroe Hall. Berkeley, Cal.: The University Press. Quarto; paper; 296 pages.

The results of a systematic study of the Southern California members of the family Compositæ. The aim is to present in an intelligible form the present knowledge of the group as it occurs within the indicated area.

The American Annual of Photography. 1908. Vol. XXII. Edited by John A. Tennant. New York: Tennant & Ward. 8vo.; paper cover; 336 pages. Price, 75 cents.

A collection of useful articles on a number of subjects of interest to the photographer, illustrated by excellent photographs.

Dairy Laboratory Guide. By Charles W. Melick. New York: D. Van Nostrand Company. 12mo.; cloth; 52 illustrations, 128 pages. Price, $1.25.

A simple and practical dairy manual, giving the underlying principles of dairy work. It begins with the most elementary problems, and touches upon the practical side only, with which every dairy or creamery operator should be familiar.

The Principles of Breeding. Thremmatology. By Eugene Davenport. Boston and New York: Ginn & Co. 8vo.; cloth; 727 pages; illustrated. List price, $2.50; mailing price, $2.70.

Prof. Davenport's treatise on this subject of widespread and popular interest is the most comprehensive work of the kind ever attempted. The author is dealing with his specialty, and his experience on the farm and in the laboratory has enabled him not only to understand the problems of the breeder but also to treat his subject authoritatively in the light of the latest developments in biological science. He has presented the science in the latest aspect, that is, he has made variation instead of heredity the initial thought. The portion treating of the statistical method of study in heredity is the first of its kind in agricultural literature. The aim of the author is to present a safe and reliable text rather than to construct new theories of evolution. He has adapted his material especially to the student in the junior year of his college course, and to the practical breeder on the farm, care having been taken to present the technical matter in a way easily comprehensible to the student of breeding who may not be familiar with the phraseology of biological literature. The text, however, is thoroughly scientific in

its treatment, and will therefore appeal to the student of evolution and sociology as well. The footnotes and references are to standard authors, and the additional references at the close of each chapter enable the student to pursue a particular subject further if desired.

THE GAS ENGINE IN PRINCIPLE AND PRACTICE. By A. H. Goldingham. St. Joseph, Mich.: Gas Power Publishing Company. Fully illustrated. 8vo.; cloth; 195 pages. Price, $1.50.

A collection of articles written for Gas Power, together with some other material bearing on the subject. To meet the requirements of the non-technical reader, calculations are simplified and explained wherever they are introduced.

STRUCTURAL DRAWING. By C. Franklin Edminster, Instructor in Department of Fine and Applied Arts, Pratt Institute, Brooklyn, N. Y. New York: David Williams Co. Oblong quarto; 74 plates; 158 pages. Price, $2.50.

A systematic course of instruction in structural drawing, beginning with the standard forms and leading to the typical columns, girders, trusses, and framing details. The drawings are made as simple as possible, and a few problems in geometry and projection are introduced for those who have not studied drawing.

NOTES ON THE CONSTRUCTION AND WORKING OF PUMPS. By Edward C. R. Marks. Second and enlarged edition. London: The Technical Publishing Company, Ltd. 12mo.; cloth; 259 pages, illustrated. Price, $1.50.

This book will prove of value to those who use pumps. Pumps for all purposes, and of all powers, are described and illustrated in the finished condition as received by users. The illustrations are mostly of machines of British make, but much of the information may be applied to pumps in general.

MODERN STEAM TRAPS. English and American. Their Construction and Working. By Gordon Stewart. London: The Technical Publishing Company. 12mo.; cloth; 104 pages, illustrated. Price, $1.25.

A little book of English origin, giving diagrams and concise descriptions of the steam traps of many makers. While many of the traps dealt with are of British make, those produced on this side the Atlantic are not overlooked.

HYDRAULIC AND PLACER MINING. By Eugene B. Wilson. Second edition, rewritten. New York: John Wiley & Sons. 12mo.; cloth; 355 pages, illustrated. Price, $2.50.

In spite of the modern tendency to business concentration, much gold mining is still done by individual workers.

HOW TO USE WATER POWER. By Herbert Chatley. London: The Technical Publishing Company. 12mo.; cloth; 92 pages, illustrated. Price, $1.

A clear elementary account of the principles and practice of hydraulic engineering. The book will be a useful one to the student or workman whose knowledge is limited, for it is plainly written with a minimum of technical description.

OLD STEAMBOAT DAYS ON THE HUDSON RIVER. Tales and Reminiscences of the Stirring Times That Followed the Introduction of Steam Navigation. By David Lear Buckman. New York: The Grafton Press. 12mo.; cloth; 143 pages, illustrated. Price, $1.25.

There is much interesting information and a number of good illustrations in this chatty little book. It glances at steamboat navigation on the Hudson during a hundred years, but for the most part deals with the early days, when a trip by water was a great event.

PRINCIPLES OF REINFORCED CONCRETE CONSTRUCTION. By F. E. Turneaure and E. R. Maurer. New York: John Wiley & Sons. 8vo.; cloth; 317 pages, illustrated. Price, $3.

In the rapidly increasing use of concrete as a building material chance methods of mixing and construction have too often been followed, occasionally with disastrous results. Builders and engineers are now gradually grasping the principles of the work, and their understanding has been helped by the publication of valuable papers and books on the subject. In the book before us the authors, who are fully qualified to speak authoritatively, cover the principles of mechanics underlying the design of reinforced concrete in a manner which cannot fail to be helpful. The theory of concrete construction is discussed and the results of many practical experiments are given. After dealing with the theory and calculations, a part of the book is devoted to very practical chapters on building construction. To the practical builder who wishes to master his trade, no less than to the engineer-architect, this book will prove most useful.

HYDRAULICS. By S. Dunkerley. In two volumes. Vol. I. Hydraulic Machinery. With numerous diagrams. London and New York. 8vo.; cloth; 343 pages. Price, $3.

A text-book by a professor of engineering, intended for use "in the universities, the Royal Navy, and for designers of hydraulic machinery." The author who for some years was connected with the Royal Naval College, Greenwich, and is now Professor of Civil and Mechanical Engineering in Manchester University, has the faculty of presenting his teachings clearly and lucidly. The chapters deal with the flow of a perfect fluid; fluid friction; pressure machines; reciprocating pumps; turbines; and centrifugal pumps. A number of pages are devoted to a consideration of the work of Prof. Osborne Reynolds.

ELECTRICAL TRACTION. By Ernest Wilson and Francis Lydall. In two volumes. Vol. I. Direct Current. 475 pages. Vol. II. Alternating Current. 328 pages. Illustrated. London and New York. Price per volume, $4.

Electrical traction has advanced so much since 1897, when the first edition of this work was published, that the authors in bringing it up to date have produced what may be considered a new work rather than a second edition of an old one. The work is divided into two volumes, dealing with direct and alternating current respectively. The various systems of electrical traction are clearly described, with many diagrams; and the authors have been wisely content to point out the advantages and limitations inherent in each system, without advancing any advocacy or preference for any particular ones.

AN INTRODUCTION TO THE THEORY OF MULTIPLY PERIODIC FUNCTIONS. By H. T. Baker. New York: G. P. Putnam's Sons. 8vo.; cloth; 335 pages. Price, $5.

The present volume consists of two parts; the first of these deals with the theory of hyper-elliptic functions of two variables, the second with the reduction of the theory of general multiply-periodic functions to the theory of algebraic functions; taken together they furnish an elementary and self-contained introduction to many of the leading ideas of the theory of multiply-periodic functions, with the incidental aim of aiding the comprehension of the importance of this theory in analytical geometry.

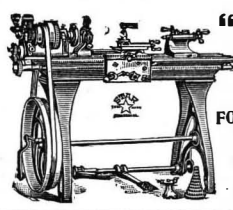
MOVING LOADS ON RAILWAY UNDERBRIDGES. By Harry Bamford. London and New York: Whittaker & Co. 8vo.; paper; 78 pages, illustrated. Price, $1.25.

The tedious and unscientific methods commonly used in practice in the preparation of tables of equivalent uniform live loads for railway underbridges led to the publication of Mr. Bamford's book. Its aim is to save much of the labor that the application of these methods involved by directly applying the funicular polygon. Along these lines a graphical method has been devised by means of which, on a single diagram, the maximum shears and the maximum bending moments, and the points along the spans at which they occur, can be determined with facility for a wide range of spans and for any given type-train.

THE RAID ON PROSPERITY. By James Roscoe Day. New York: D. Appleton & Co. 12mo.; cloth; 352 pages. Price, $1.50 net.

James Roscoe Day, LL.D., stands for principles that are perhaps not often held by the head of a great seat of learning, or at any rate for principles that the head of a great seat of learning is not often willing to support in public. "The Raid on Prosperity," his latest book, is a vindication of the complex commercial systems that have arisen in our country, and a very just and clear statement of the duties of citizenship and of other duties more intimately associated with the individual. Chancellor Day discusses his subject with freedom from bitterness or rancor, and gives many suggestions that are useful and beneficial, especially as in a number of cases he brings back to our minds civic obligations, of which most of us have been more or less negligent.

THE EXALTATION OF THE FLAG. By Robert B. Westcott. Manila, P. I.: John R. Edgar & Co. 16mo.; boards.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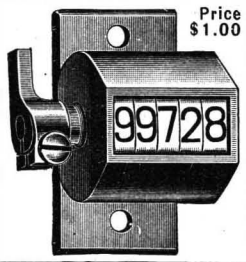

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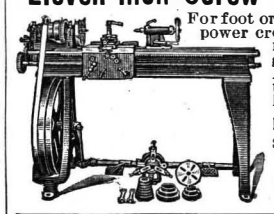
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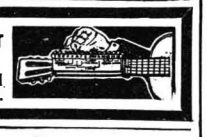

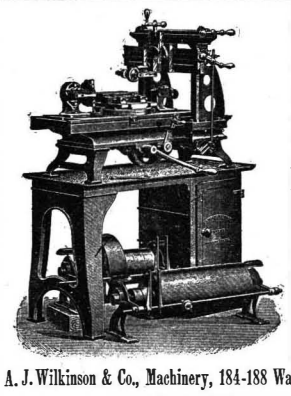
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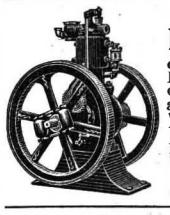
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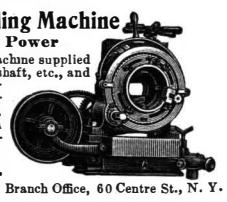

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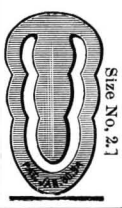

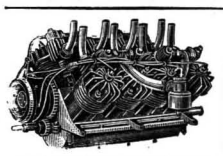

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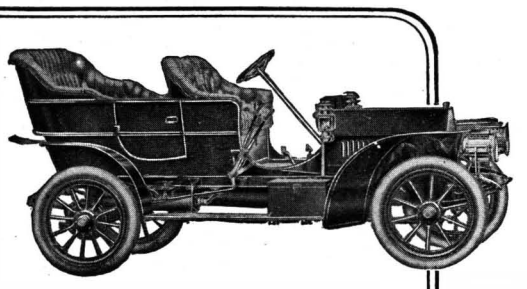

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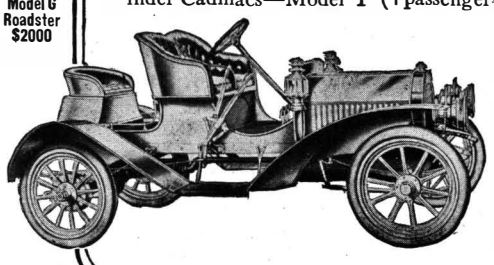

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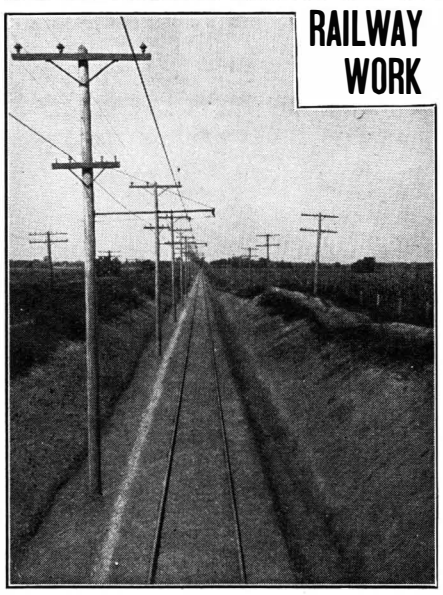

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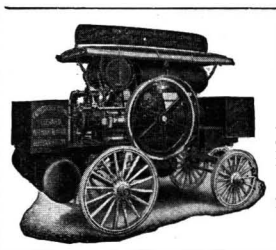

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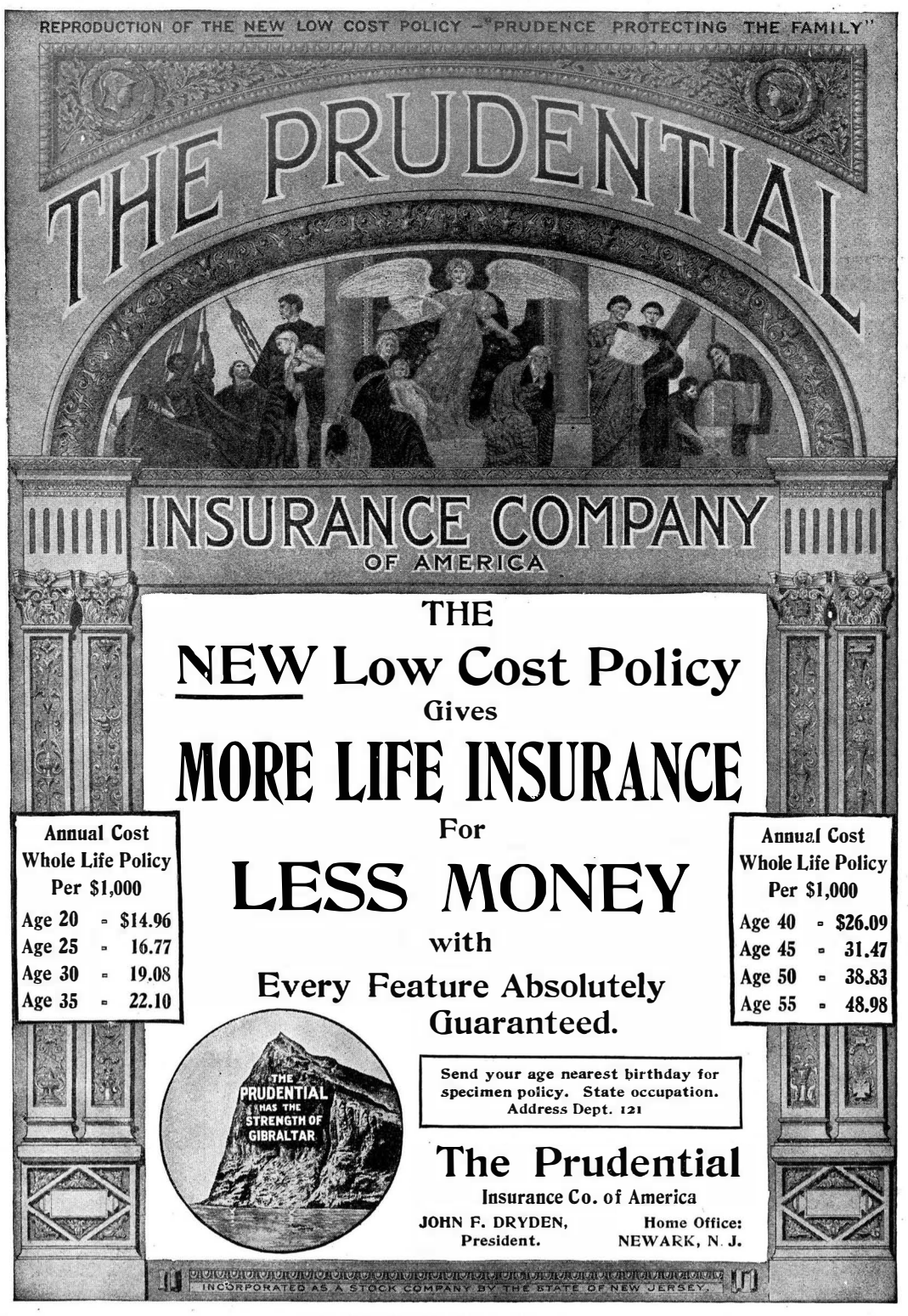
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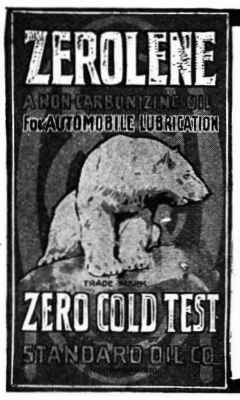

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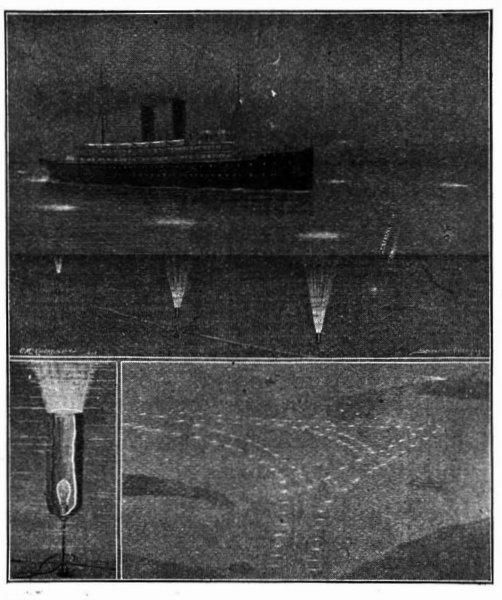

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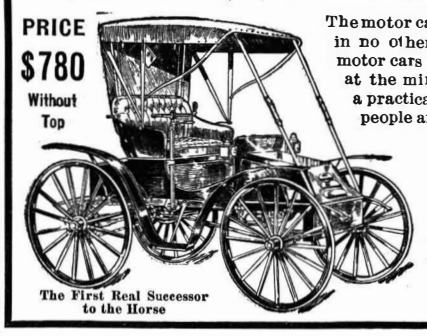

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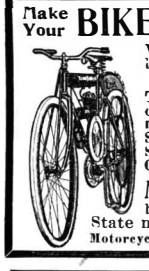
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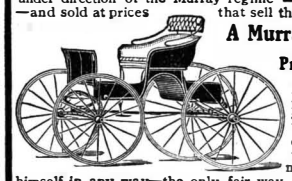
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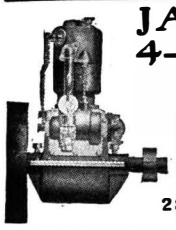
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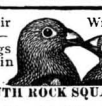
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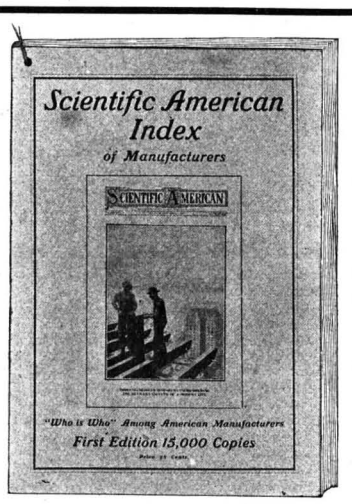

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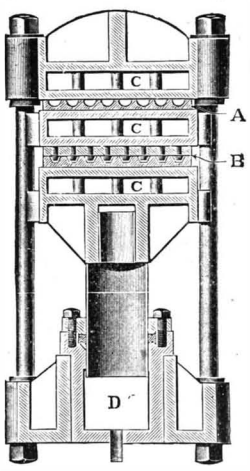

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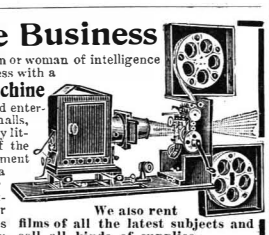

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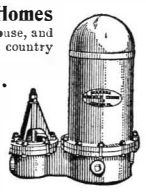

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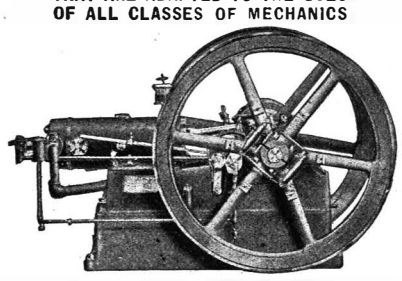

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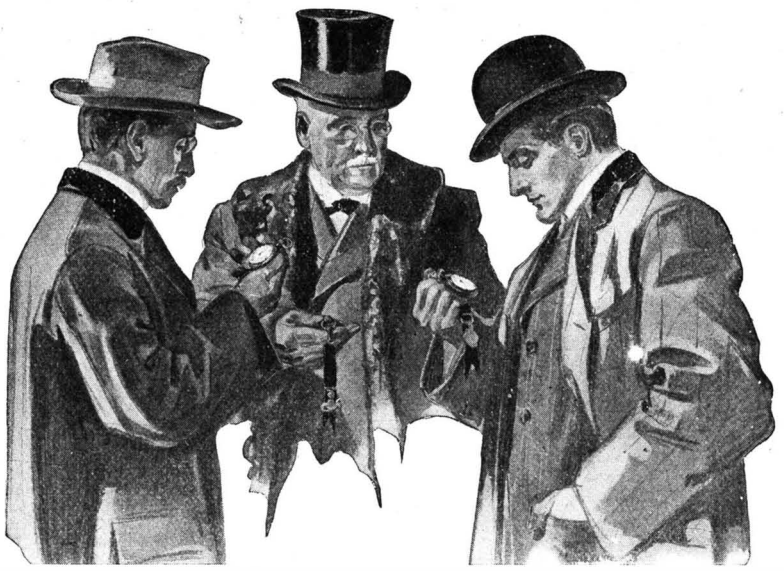

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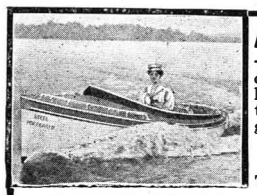

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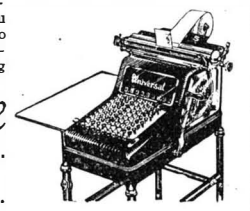

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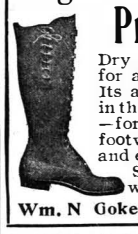

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